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NUMBER 1

ECONOMIC GEOGRAPHY



JANUARY

AGRICULTURAL REGIONS OF SOUTH AMERICA

Clarence F. Jones, *Economic Geographer*, Clark University

THE POTATO INDUSTRY IN NEBRASKA

Esther S. Anderson, *Geographer*, University of Nebraska

AGRICULTURE IN THE DRY REGION OF THE U.S.S.R.

N. M. Tulaikov, *Director*, Agricultural Experiment Station, Saratov

THE GERMAN SUGAR BEET INDUSTRY

E. Muriel Poggi, *Geographer*, University of Illinois

DIVISIONS OF THE PINE FOREST BELT OF EAST TEXAS

William T. Chambers, *Geographer*, Stephen F. Austin State Teachers College

ARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

OUR CONTRIBUTORS

Dr. Jones, professor of economic geography at Clark University, in Instalment VII of the *Agricultural Regions of South America*, concludes the series of articles on South America. The materials on the agricultural regions of South America, somewhat revised, are soon to be published in book form by Ginn and Company.

Miss Anderson, who is instructor in geography at the University of Nebraska, now on leave of absence for graduate work at Clark University where she hopes to receive her Ph.D. degree in June, 1930, has done extensive work in this field, and has contributed several interesting articles to various geographic magazines, the latest being "Nebraska," to appear in the revised edition of the *New World Encyclopaedia*.

Dr. Tulaikov, who contributes an article on the "Agriculture in the Dry Region of the U. S. S. R.," is director of the Lower Volga (formerly Saratov) Regional Agricultural Experiment Station and is in charge of the Division of Field Husbandry. Formerly, he was chairman of the Agricultural Scientific Committee, which is now being called the State Institute of Experimental Agronomy. Most of his larger works are published in Russian, although several on the agriculture of the dry area of the U. S. S. R. have appeared in English, American, and other European publications, some of which are "The Genetic Classification of Soils," in the *Journal of Agricultural Science*, Volume 3; "Drought and the Means of Overcoming Its Evil Effects in the Volga Region of East Russia," in the *Journal of the American Society of Agronomy*, Volume 15, w. 1; and "The Utilization of Water by Plants Under Field and Greenhouse Conditions" in *Soil Science*, Volume XXI, w. 1.

Miss Poggi is instructor in geography at the University of Illinois where she took her M.A. degree in 1928. She trained in geography at the London School of Economics, University of London, specializing on European topics. Her article on the "Red Land of Gwent" in a previous issue of *Economic Geography* was the result of personal field work.

Dr. Chambers, who is now professor of geography at the Stephen F. Austin State Teachers College, Nacogdoches, Texas, holds the B.A. degree from Indiana State Teachers College and the M.S. and Ph.D. degrees from the University of Chicago. Dr. Chambers is teaching near the boundary between the regions treated in this article.

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SUGAR

SUGAR has become one of man's best foods. Its nutritive value, its concentrated form, its wide adaptability to use with other foods, its relative ease and low cost of production, the variety of sources from which it may be obtained—all these combine to make it almost indispensable in man's economy as well as in his dietary.

"A land flowing with milk and honey" was man's early ideal of a desirable homeland as soon as he had become a pastoralist or a farmer; and this ideal is essentially unchanged in the highest civilization of today, except that for the sweetness of honey man has substituted the sweetness of sugar. The early man knew nothing of sugar but he did know of the rich sweetness stored in the wild bee's hive, and the milder sweetness of the juices of some trees and fruits and canes and roots. Few indeed there were who did not seek, and find, some form of sweetness for part of their food. The civilized man draws upon all these sources and his consumption of sugars has increased hundred-fold over the earlier man's happiest dreams.

From tropic isles he draws vast stores of cane syrup and sugar—Cuba, Hawaii, Java, the Philippines—wherever the sun is warm, the waters are plentiful, and the soil is tillable. From temperate plains he draws other great stores of beet sugar—from the black soil stretches of Europe, of America. From cooler lands he draws the sweet sap of the maple tree, most aromatic of all. A great industry has grown up in the production of these sugars, in their manufacture and their distribution; an industry that modifies the economic and political life of all the civilized peoples of the world. Almost, the stage of a people's culture, its progress and activity, may be gauged by its consumption of sugar.

Honey has not lost its savor, its strength and health-giving virtues. The honey of the Judean hillsides is still eagerly sought; the honey of Hymettus still flows sweet and satisfying; the logwood honey of Jamaica, the white clover honey of the American prairie pasturelands, the wild sage honey of the Southwestern arid plains, the sourwood honey of the Carolina mountains, the tupelo honey from the Southern bayous—all these enter the world's trade and find their friends among epicurean palates. But the world's bees can no longer satisfy the needs of the world's busy men for sugar foods, and the cane and the beet hold first place in civilization's larder!

ECONOMIC GEOGRAPHY

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No. 1

AGRICULTURAL REGIONS OF SOUTH AMERICA

INSTALMENT VII

Clarence F. Jones

Economic Geographer, Clark University

NORTH ANDEAN CROPS AND GRAZING REGION

FROM near the southern border of Colombia in the great Pasto Mountain knot, the North Andean Crops and Grazing Region stretches to the north and east for 1,400 miles, ending in the mountainous peninsula of Paria. Bordered on the west by the Pacific tropical forest and on the north by the tropical forests of the lower Cauca and Magdalena Valleys and the Maracaibo Lowland, by the arid plateaus of Barquisimeto, and by the Caribbean, it bridges the Cordillera ranges and valleys, extending down the eastern flanks of the Eastern Cordillera to the tropical forests in Colombia and to the savannas of the *Llanos* in Venezuela. Though a narrow region, for the most part, it embraces by far the most important agricultural sections of both Colombia and Venezuela. It has a large part of the cultivated land of the countries, a goodly share of the stock, and in addition to a large variety of subsistence commodities, produces the principal commercial crops of the two republics. Within

its confines are the chief concentrations of population, the chief cities, and, except for the lower Magdalena, the major transportation facilities. Yet, most of the area depends upon pack animals for the movement of produce to railway and river from isolated mountain recesses and deep valleys.

PHYSICAL CONDITIONS

Variety of physical conditions characterizes the North Andean Region; few areas in South America exhibit such sharp contrasts within short distances. At places there are deep fertile humid tropical valleys with lazy mulatto; at others, hot gorges supporting only cactus and thorny growths; on the steep humid slopes the deep green of the coffee *fincas*, carefully tilled by the industrious highland mestizo; higher up, clothing many a steep slope, the patchwork of temperate cereals garnered by struggling highland Indian; verdant grassland slopes and summits dotted with the huts of the pastoralist; the cold cloudy *paramos* with their heath-like and resinous plants and *ichú* grass,

and above all the eternal snows of the towering Cordillera.

RELIEF

The major relief features of the north Andean Region include the three ranges of the Cordillera in Colombia, separated by the deep Cauca and Magdalena Valleys and the Eastern Cordillera, which extends northeast, skirting the Caribbean in Venezuela. Extremely rugged, these ranges, in contrast to those in the Central Andean Crops and Grazing Region, enclose few high broad pampas or plateaus. For the entire area few level stretches of any extent exist and they do not constitute the chief agricultural lands. The western part of the region is marked by the bold, high, Western Cordillera, affording few low passes. This range drops off sharply to the Cauca Valley, about 15 to 25 miles wide, 150 miles long, and from 2,500 to 3,500 feet above sea level. North of Cartago the mountains hem in the valley which becomes a mere ribbon between huge walls of sandstones and shales. From its rolling to flat surface the land to the east rises rapidly in places in rounded hills, and in others in steep valleys to great heights in the Central Cordillera. This range occupying a vast extent of land consists of a great north-south backbone with peaks rising to more than 18,000 feet. Its flanks deeply carved by numerous tributaries of the Cauca and Magdalena support a fairly dense agricultural population especially the western slopes from 3,000 to 9,000 feet. The Upper Magdalena from 1,000 to 3,000 feet above the sea, like the Upper Cauca, has stretches of level lands, but mountain spurs come to the river's edge in many places. In the broad eastern range of mountains

a few high plateaus or savannas afford stretches of level land; among these the important ones are the Savanna de Bogotá, a level plain about 30 miles wide and 75 miles long and 8,700 feet above the sea; the Sogamoso, much smaller and only 8,200 feet above the sea; and in Venezuela, the Valencia Basin, about the size of the Savanna de Bogotá, and approximately 1,500 feet above sea level. But most of the Eastern Cordillera, from the southern border of Colombia to the forested head lands of the Paria Peninsula, consists of high mountains and deep valleys, whose moist slopes provide the chief farming lands of the eastern part of the region.

CLIMATE

Corresponding with relief and altitude are marked contrasts in climatic conditions. Four temperature zones based chiefly on decreasing temperatures with altitude include (1) the tropical zone, up to near 3,000 feet, where the mean annual temperature is from 83° to 75° F. with little range from month to month; (2) the subtropical to temperate slopes and valleys from 3,000 to 6,500 feet or thereabouts, with mean temperatures of 75° to 63° F.; (3) the temperate lands of high plains and mountains from 6,500 feet to near 11,000 to 12,500 feet, with mean temperatures from 63° to 50° F.; and (4) the *Paramos* and snow-capped Cordillera above 11,000 to 14,500 feet, cold windy regions all of the time. The altitudes at which these climates are found vary considerably with latitude, exposure, and meteorological conditions, but within ten degrees of the equator they are quite fixed and accepted as fair approximations to the truth (Fig. 123).



FIGURE 123.—The Central and Eastern Cordilleras have considerable areas of high *paramos* and snow-capped mountains, areas utilized only for a little summer grazing; El Ruiz, 14,700 feet. The slopes below the glacier support a very sparse vegetation.

For the region as a whole precipitation ranges as much as temperatures. Exposed slopes at intermediate elevations receive large amounts in heavy

the Caribbean, there are two rainy seasons at the time of maximum elevation of the sun separated by two seasons of little rain. In the north-



FIGURE 124.—In the Eastern Cordillera, one day's ride south of Pamplona. Temperate grazing lands on the lower edge of the *paramo*, 11,500 feet. In the distance, typical cold clouds and mists rolling up the valley.

convictional showers. Deep, narrow sheltered valleys and lowlands along the Caribbean receive almost no rain, exhibiting desert flora. Except for the portion of the region bordering

eastern part most of the precipitation comes in one long season from May to October inclusive. But exposure and altitude cause large contrasts. The eastern slopes of the Western

Cordillera and the flat floor of the Cauca Valley, exhibiting dry conditions, receives from 30 to 40 inches of rain per year. The western flank of the Central Cordillera from Medellín to Popoyan at 4,000 to 7,000 feet receives a rather heavy precipitation from 45 to 75 inches and possibly a little more in places. In precipitation the middle Magdalena presents a close parallel to that of the Cauca and the bordering ranges. Within the eastern range the broad savannas and basins receive a medium amount of precipitation; Bogotá (8,727 feet) 40 inches, Valencia (1,800 feet) 51 inches, and Caracas (3,420 feet) 32 inches (Fig. 124).

VEGETATION

From sheltered valley to bold slope everywhere striking contrasts of precipitation show similar contrast in crops and vegetation. Along the Caribbean coast a sparse growth of zerophytic forms, cactus, acacia, divi-divi, algarroba, and others change gradually with elevation to a heavier forest growth high on the flank of the mountains. Over the divide of the northern range the southward-facing slopes are chiefly grass-covered, except for strips of trees along the ravines. The level floor of the Valencia Basin, where not in crops, consists of savanna lands—tall grasses interspersed with several species of trees. Numerous small sheltered valleys within the region have desert-like flora, but the two large areas of semi-arid vegetation include the Upper Cauca and the Upper Magdalena Valleys. Here, forests are largely restricted to the banks of streams and low-lying areas; over much of the surface the grasses and bushy thorny growths show plainly their adaptation to drought. Everywhere at

lower elevations in moist places are true tropical forests which extend up to near 3,000 feet. A subtropical forest clothes the slopes from 3,000 to near 6,800 feet including many tropical species as well as tree ferns, oaks, and walnuts, and in the *Inga* the valuable coffee shade tree. This subtropical



FIGURE 125.—The tall tree fern reaches its best development in the subtropical forest on the intermediate slopes of the Cordillera.

forest grades into a temperate zone of good timbers where plenty of moisture is available, this in turn giving way, from 8,000 to 9,000 feet, to the cold grasslands, which are replaced by the bleak *paramos*, areas of hardy grasses, mosses, ferns, the woolly *Espeletia*, and some sprawling shrubs (Fig. 125). Belonging to the better



FIGURE 126.—In the coffee region of the Central Cordillera. The coffee trees are well cared for, being pruned properly and sometimes intertilled. Near the upper border of the coffee zone at 6,000 feet little shade is required. In this picture the shade trees are *inga*. Excellent coffee is produced on the well drained soils of these humid valleys.

temperate grasslands are the intermontane savannas, the most important of which is the Savanna de Bogotá; its vegetation consists chiefly of temperate grasses, only two trees, an oak (*Querces Humboldtii*) and the eucalyptus being present in numbers. The latter tree, introduced several decades ago, now lines all the farms, fields, roads, and even the streets in the villages on the savanna.

AGRICULTURE

Throughout the North Andean Region, like the physical conditions, farm lands, crops, and animals show striking variations within short distances. The region produces almost the entire list of tropical and temperate products, but only a few have risen to commercial significance.

Coffee and cacao are shipped to foreign countries in large quantities, the products being the financial backbone of both Colombia and Venezuela, until replaced by petroleum in Venezuela. While grown almost entirely for local use, some produce within the region moves from valley to mountain, from tropical to temperate climes, and vice versa, though, in general, the distances covered by any commodity are not great owing to general zonation of crops with rugged relief and the inadequate transport facilities.



FIGURE 127.—A coffee drying floor in the Sierra Nevada de Merida of Western Venezuela; near San Cristobal. The coffee bushes at the lower altitudes in this region are well shaded by *inga* trees.

COFFEE

Coffee dominates agriculture in much of the North Andean Region. Though occupying but a small per cent of the total area, it is widely dispersed in the highland valleys from 2,000 to 6,500 feet, the better coffee

coming from the middle and upper portion of this zone. The chief areas of production include (1) the western flank of the Central Cordillera from Medellín south to Popoayan, (2) the western flank of the Eastern Cordillera from Ocaña south to Neiva, (3) the northern valleys of the Eastern Andes from Pamplona in Colombia to East of Caracas in Venezuela, (4) the deep valleys within the Eastern Andes in Venezuela, including portions of the Lake Valencia basin, and (5) smaller areas on the eastern flank of each of these ranges where moisture and other conditions are favorable (Figs. 126 and 127).

The significance of coffee culture in the agricultural economy of the region results in a large measure from auspicious physical conditions. Most of the coffee plantations occupy regions of rugged relief, but the steep slopes, often of 25° to 30° angles, in deep valleys, provide the free movement of soil moisture so essential to the coffee tree. Also, these deep valleys are sheltered from desiccating winds and strong winds that would break heavily laden trees, where they are not pruned. On these slopes red fertile soils high in potash and iron and several feet deep aid in producing good yields. Temperatures ranging from about 58° to 78° F. are most favorable; on the lower hot slopes large strong berries grow, trees require much shade, and considerable attention; higher up trees yielding smaller and milder berries, require less shade and only a fair amount of attention, but they have a shorter life. Although varying greatly, the annual rainfall of from 40 to 70 inches in normal years is well distributed for the proper flowering and fruiting of the plant and for harvesting and drying the berries. During the rainy

season mists and clouds drift up the valleys in the hottest part of the day and drench the coffee trees with a convectional shower and shelter them from the hot rays of the noonday sun. A combination of these physical conditions and good methods of preparation give to Colombian and a small part of Venezuelan coffees their distinct qualities; as mild coffees, valuable for blending, they contain a large proportion of essential oil, low weight of ash, high caffeine content, great density, and uniform green color of berries.

Plantations in size and in number of trees vary greatly in different parts of the region. Most of the coffee *fincas* in Venezuela embrace considerable areas, but in the western portion several small holdings exist. In Colombia the average plantation has about 9,000 trees; only about 225 contain more than 100,000 trees; the great majority have less than 5,000. In the region on the western flank of the Central Cordillera the small coffee producer dominates. Here, small plantations are owned by individual farmers who, with large families, take care of all the work of the plantation. This section produces the best-quality coffee and the greatest yield per tree.

As with the size of plantations, the region exhibits marked contrasts in methods of culture. On only a few of the large estates of Venezuela do modern methods exist. In general, the coffee tree, never pruned, grows from 10 to 14 feet high, and has a large number of non-bearing branches; the yields of unpruned trees decrease rapidly after a few years (the average yield for Venezuela being less than one-half pound per tree per year according to H. Pittier). Other poor methods include: no seed selection,

new plantings being made from seedlings that spring up under trees from dropped berries, no fertilization, too much shade, no attempt to cope with diseases and pests, and the picking of both green and ripe berries from a branch with one stroke of the hand down the branch, destroying many of the new buds at the same time. These same methods exist in the portion of Colombia adjacent to Venezuela, but there efforts are being made to improve conditions. In other parts of Colombia methods of tillage and preparation compare with those in the best coffee regions of the world. Trees are planted systematically at distances of about five feet on fertile soil or 8 to 10 feet on less fertile soil; shade trees of *pisquin* (*Erythrina edulus*) and *guamo* (*Inga vera*, *I. sapida*) are placed at 35 to 50 feet, distance varying with altitude. The land is tilled once or twice a year. In spite of a labor shortage only ripe berries are picked; two pickings a year in most sections yield from one-half pound of cleaned coffee per tree per year to one and three-quarters pounds in the better districts of Antioquia. At the same time a far better-quality berry is the result (Fig. 128).

The industry labors under other handicaps. Owing to attractive work and wages in construction units and the oil industry and to the ease of life in some sections, there is always a shortage of labor which often becomes acute at harvest time. Recent estimates place the portion of the crop lost, for want of laborers to gather it, at 15 per cent of the total. Just before the harvest, urgent calls for laborers are posted in frequented places in all Andean recesses. Few immigrants come to these parts. When gathered and prepared for

shipment the coffee meets high freight rates to the coast, except for portions of Venezuela near the sea; in other sections months may elapse before the crop reaches ocean shipping (Fig. 129).

The region as a whole can witness considerable expansion of the coffee industry. Many virgin slopes only



FIGURE 128.—All the coffee districts of the North Andean Crops and Grazing Region occupy rather rugged steep slopes at intermediate elevations. (From "Commerce of South America," C. F. Jones. Courtesy of Ginn & Company.)

await planting to produce abundant crops. As trails, highways, and railways are completed, many areas can increase the output, providing sufficient labor can be procured and a world market can consume the surplus.

CACAO

More exacting than coffee in its physical requirements and necessitating much time, labor, and careful preparation of the bean, cacao occupies much less land than coffee. The chief areas of production include (1) the Coast Range of Venezuela from west of Puerto Cabello to Carenero and inland in the deep valleys to the south of Caracas; (2) the lower levels of the Andes to the southeast of Lake Maracaibo in

Trujillo, Merida, and Tachira; (3) the Middle Magdalena Valley especially in Ocaña; and (4) small patches in the Upper Cauca Valley. In these areas the plantations occupy the level narrow valley floors of alluvial clay loam soils and extend up the slopes on heavy red clay soils to elevations of 3,000 feet or somewhat higher. Constantly high temperatures; a rainfall of 40 inches or more, usually more; prevailing high humidity; the absence of desiccating winds; and good drainage determine the specific areas to be selected for cacao culture.

Though conditions of culture vary considerably from one district to another, in general, from 200 to 250 trees are planted to the hectare, large virgin forest trees being left for shade instead of being planted as on the better-managed coffee estates. While trees are young, corn or other subsistence crops may be grown between the rows. Once in bearing the trees receive little or no attention except for the gathering of the crop. As compared with coffee, cacao requires more care in preparation and shipping, the product being delicate and subject to fermentation, mold, and damage from dampness and heat. Diseases, especially the diseases occasioned by the gray moth and black pod rot, and the cacao beetle do much damage. Several varieties are grown, but little attempt is made to sort and grade the beans. Since the cacao bean cannot be stored for considerable time in hot humid area, the meagre transport facilities in remote sections hinder greatly cacao culture. Also, the shortage of labor in all areas retards expansion.

COTTON

Of minor importance commercially, cotton has been grown for a long

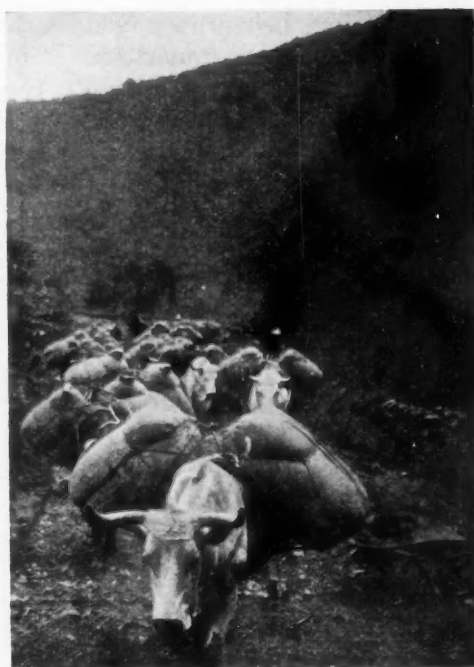


FIGURE 129.—Sacks of cacao being transported from the Cauca Valley to Medellín, whence they move by rail and the Magdalena river to Puerto Colombia for export. In parts of the North Andean region cattle are the chief pack animals.

time in different portions of the region, especially in (1) the Valencia Basin and the dry valleys near Caracas, (2) in the department of Tolima and Boyaca in Colombia, and in the Upper Cauca Valley. In all these areas fertile clay and sandy loam soils, fairly large areas of level land, a long rainy season followed by a dry sunny harvest period, and high temperatures favor cotton culture. The fibers produced are fairly long and of good quality, but badly colored and mixed; in the Cauca Valley area a half a dozen different varieties grow in the same field; no attempt is made to grade or standardize them. Though the terrane would allow the use of modern machinery, only a few are employed on the large plantations. Some of the cotton consists of the annual varie-

ties, but much of it is perennial. At present a great deal of the cotton grows on large plantations, with corn and beans between the rows as supplementary crops. Often these crops pay for all the labor on the plantation, except for the picking. Owing to shortage of labor at picking time, and careless methods, as much as 20 to 25 per cent of the crop may be left in the field. As with other crops, insect pests and diseases do much damage and nothing is done to restrict their ravages. Considerable areas possess the physical requirements for cotton culture, but many improvements in seed selection, planting, tillage, picking, and grading must come before the region ranks high as a cotton area.

SUGAR

More widely distributed than either cacao or cotton, sugar constitutes an important crop in most sections of the North Andean Region up to 6,000 feet elevation. Grown on nearly all large cacao and coffee estates, it occupies considerable area on a few *haciendas* producing nothing but cane and its products, especially in the Valencia Basin, the Cucuta Region, numerous small arid valleys in the Eastern Cordillera where water is available for irrigation, and in the Magdalena and Cauca Valleys. With fertile clay soils and a fair distribution of water, cane grows year after year on the same land without replanting. Records show that cane fields have not been replanted in the last 20 years (in the Cucuta Region and the Medellín Valley), a ratoon crop being cut every 12 to 14 months; some fields have grown cane for 100 years without rotation or fertilization. The cane gets only one or two cultivations

with a hoe per season. Consequently the yields of cane and sugar content are low; yields of 5 to 10 tons of cane are considered good in many sections. "*Gomosis*" and "*Mosaic*" infest most areas. Only a few large centrals exist in the whole



FIGURE 130.—Below the coffee plantations in the narrow fertile valleys are areas of sugar cane, an important crop throughout the North Andean Crops and Grazing Region up to 6,000 feet above sea level.

area; most estates manufacture in a crude small mill the *panela* or the *papelón*, the brown cake sugar so valuable for man and beast; but much of the sugar goes for the manufacture of *chicha* or *aguardiente*, the chief beverage for the laboring classes (Fig. 130).

TOBACCO

Of long standing, tobacco culture, though carried on in many sections, occupies much less land than the major commercial crops or the chief subsistence products. Tobacco is cultivated in numerous small valleys on sandy clay loam and sandy loam soils in rather small areas at intermediate elevations. In contrast to sugar cane, little is irrigated, the farmers depending upon precipitation for a moisture supply. Tobacco re-

ceives more care in cultivation than many other crops. The tender plants, transplanted from nursery beds to well-prepared soil, are cultivated with hoe two or three times a season. But, being grown by small farmers almost entirely, vast room exists for improvement in seed selection, care of the plants at gathering time, drying, curing, and grading (Fig. 131).

cleared or burned-over lands in the establishment of a cacao or coffee plantation; it does well on steep slopes and poor soil areas, producing big ears of good quality. The brown to black soils of the Valencia Basin, the Magdalena and Cauca Valleys give high yields of fine corn, even without much care. Only in a few of the better-farmed areas is corn carefully tilled; planted in rows vary-



FIGURE 131.—At intermediate elevations tobacco is an important crop in several portions of the North Andean region. With fertile soils and fairly favorable temperatures and rainfall good tobacco is produced. Poor methods of treating and curing, however, yield an inferior product everywhere. Photograph near San Cristobal, Venezuela.

LOW ALTITUDE SUBSISTENCE CROPS

Almost every large coffee, cacao, cotton, and sugar estate has its quota of subsistence crops, including corn, beans, cassava, bananas, and other subtropical products. Also, Indians and mestizos living in remote valleys, away from any large plantations, subsist by the desultory tillage of such crops.

Corn, little used as a feed, constitutes a staple food for the lower and middle classes of the North Andean Region from sea level to 8,000 feet or a little higher; in addition, it serves for the manufacture of quantities of *chicha*. It grows as the first crop on

ing in width, it may be cultivated in some areas once with a one-oxen wooden plow or with a hoe; in other areas only the weeds are cut out with a machete. Usually pole-beans planted with the corn use the stalk as a support. Cassava often planted between the corn rows serves to keep down weeds and at the same time adds materially to the food supply. Though occupying more land than any other crop, a wide movement of corn is restricted by several conditions; corn has a high percentage of moisture and does not keep well; it cannot be stored more than a few months because of the weevil; transportation

costs are prohibitive for such a bulky commodity; many valleys may have a large surplus of corn at harvest time, unable to dispose of it even though corn brings \$3.00 per bushel in a highland station 50 or 100 miles away. Only in the form of *chicha* can it traverse distances and yield a profit.

Up to 6,000 feet bananas find a significant place on large and small farms. A few plants near a laborer's hut provide an abundance of starch foods from year to year without any labor; on the coffee estates bananas not only supply the chief food, but in many sections serve as shade for the tender young coffee plants and at the same time keep down the weeds between the coffee bushes. Near large towns more extensive banana fields indicate a commercial production for the urban districts; also, frequently on the trails trains of mules wend their way to highland towns with loads of bananas. Though bananas grow up to 6,500 feet in sheltered places, the size of the plant and the fruit decrease with elevation, those grown at the upper limit being of little value.

TEMPERATE CROPS

Between 6,500 and 7,500 feet a marked change takes place in the agriculture of the North Andean Region. Coffee, bananas, cassava, breadfruit, and other crops give way to wheat, corn, barley, root crops, and vegetables. Though corn grows to nearly 9,000 feet on steep slopes and on stony poor soil, giving good returns, small grains, root crops, and vegetables assume the dominant rôle. Within twelve degrees of the equator the higher parts of the region are areas of temperate agriculture in most respects (Fig. 132).



FIGURE 132.—Above the coffee, banana, and cassava region temperate crops occupy all of the tilled land. On the steep slopes around 7,000 to 8,000 feet corn is an important crop. It does fairly well on slopes of 20 to 30° angle as represented in the photograph. In the highlands of Antioquia near Medellín.

Of long standing, wheat culture engages the attention of most highland farmers. It grows in large areas on the level lands of the region as in parts of the Valencia Basin and the Savanna de Bogotá and climbs high up the steep mountain slopes, especially in the high mountains of western Venezuela, the Eastern Cordillera in Colombia and the high mountains of southern Colombia. In these places the fields of golden grain occupy much of the farm land up to 10,000 feet elevation. Many varieties of native wheat, most of which are resistant, produce a kernel of good quality, but everywhere yields average low, from five to seven bushels; in exceptional places and under unusual conditions 10 or 12 may be obtained. Despite widespread culture, the yields do not supply the demand, imported wheat and flour being consumed in quantities in the region. Local wheat may command a price of

\$5.00 per bushel, and still yields remain low (Fig. 133).

At higher elevations and on infertile soils barley replaces wheat in many places and in Southern Colombia *quinoa* retains the position among the crops which it holds in the Andes farther south. As with wheat, the quality of the grain is good, but yields are low, due not so much to

ANIMALS

Cattle, sheep, mules, poultry, and swine find a place in the agricultural economy of the region, the llama, the great burden bearer of the Central Andean Region, and the alpaca, being almost absent in this portion of the highland. Only in high parts of southern Colombia do they graze in considerable numbers. For the re-



FIGURE 133.—In the Sierra Nevada de Merida, Venezuela. Nestled in the deep valley is a small stagnant town established centuries ago. On the slopes in the distance are the temperate small grains and root crops. In the immediate foreground are patches of corn to the left and in the center a modern threshing floor enclosed by a stone wall. Here animals tramp out the grain from the sheaves as in the days of old. (Courtesy of H. Pittier.)

adverse physical conditions, but to poor methods of culture.

Throughout the high sections up to near 12,000 feet the Irish potato comes into its own, supplying much of the food for the poor farmer, while *aracacha*, a small tuber, and several vegetables add variety to the diet. They are tilled in small patches on steep slopes adjacent to the houses or where a tiny patch of soil promises a fair yield.

gion as a whole, cattle and mules are the principal animals, sheep being less important than in the Andes farther south, owing chiefly to the lower elevations of the major concentrations of population. Swine and poultry are kept in small numbers on most estates and small farms; one can always obtain fresh eggs in the most remote sections of the Andes, while boiled chicken all but becomes a national dish.



FIGURE 134.—Fine *Guinea* grass pasture near San Cristobal, Venezuela. At the lower elevations *Pará*, *Guinea*, and *La India* are the only important forage grasses for stock. Excellent when young, they become dry and hard in the dry season. In the North Andean Region most of the grasses below 3,000 feet are of these types. (Courtesy of C. E. Cormany.)

Including a number of grasses the grazing lands embrace a significant portion of the entire region; many mountain slopes formerly forested have been cleared and planted to various types of grasses and support many cattle, sheep, and mules. In the low flat heavy clay lands of the Valencia Basin, the Cauca and Magdalena Valleys and many smaller wet valleys, *Pará* grass grows luxuriously; in the same regions only on drier lands two other bunch grasses, *Guinea* and *La India*, replace *Pará*. Excellent forage when young and tender, these coarse bunch grasses become hard and dry each season; *La India* is especially bad for cutting the mouths of grazing animals. These bunch grasses extend, as the upper limit, to elevations varying from 3,000 feet to 4,500 feet depending on soil and moisture. In the Cauca Valley nearly all forage grasses below 2,500 feet belong to these types. In general higher up the grasses consist of *gramma* and many other short grasses that clothe the slopes up to the Paramo with a carpet of green during the rainy season. In some areas in the temperate heights blue

grass, orchard grass, and rye grass have been planted, especially on the Savanna de Bogotá, where more than half the area of the level Savanna is in pasture. On the subtropical slopes, 2,800 to 5,000 feet, in the Central Cordillera, especially in Antioquia and Caldas, most of the land not in coffee or other crops has been planted to *Yaragua* grass, a rapidly growing grass, that covers the ground, is almost tick free owing to small globules of oil on the stems, and is an excellent forage; to it Antioquia owes much of its importance in the cattle industry giving high-grade dairy and beef cattle—the *orajo negro*, black ear cattle (Figs. 134 and 135).

In all this territory only three areas have developed a fairly high-grade industry: (1) the Valencia-Caracas area, (2) the Savanna de Bogotá, and (3) the Medellín region of Antioquia. Here some of the animals have been improved by the importation of pure-blood stock in considerable numbers; a dairy industry has developed for supplying the urban centers, but Antioquia has the best cattle industry of the entire region. Many farmers subsist principally on the dairy prod-



FIGURE 135.—In the Central Cordillera, especially in Antioquia, and in places in the Eastern Cordillera on the subtropical slopes 2,500 to 5,000 feet much of the grazing land has been planted to *Yaragua* grass. It is excellent forage, and having small globules of oil on the stems, it is almost tick free. Highlands near Medellín.

ucts, meats, and hides derived from the herds; most anywhere in this section of the Central Cordillera one can procure along the trail, a fresh glass of milk from the cow's udder. The black ear cattle of this region illustrate what may be done throughout the highland in producing high-grade products (Fig. 136). In all other areas the cattle consist of old *creole* stock; rough bony cattle are used chiefly for draft purposes and pack animals; seldom butchered younger than 4 years of age, they give an inferior quality meat even when fat (Fig. 137).

While the cattle industry reaches its greatest development at intermediate elevations, sheep graze chiefly on the higher pastures, and the *paramo* is almost exclusively their domain. Only in the cool moist areas of the higher portions do they find optimum conditions. But most

of the animals consist of low-grade stock, growing only small fleeces of medium-grade wool. Most everywhere the omnivorous "porker," tall, thin, bony, and "long-snouted," roots for a living, though many small coffee farmers have no use for this troublesome animal. Chickens, like swine, pick their own living and are kept by most farmers, being allowed the free range of the patio, and frequently the kitchen and dining-room.

LAND TENURE AND AGRICULTURAL METHODS

Except for the small coffee farmers of the Central Cordillera, in Antioquia, Caldas, and El Valle, most of the land of the North Andean Region is held in vast *haciendas*, the estate being managed by a *major-domo*; the land owner, as a rule, spends little time on the estate, except during the



FIGURE 136.—The black-ear—*orejo negro*—cattle of Antioquia are the best dairy and meat cattle of the North Andean Region. In this area many small farmers subsist primarily on the meats and hides derived from the herds.

planting and harvesting seasons. On each estate the attached laborers, supplied with fenced and cleared land, tools, draft animals, and seed, and subsistence in advance on account, farm an allotted portion of the estate for a part of the produce, usually one-half of the crop in the field at the end of the season; the laborer is paid for assisting in the harvest of the owner's half at day wages or by contract, if he performs this necessary part of the crop labor. This system prevails for most types of farming, but in the extension of coffee or cacao acreage laborers will be given all the produce they can raise from a piece of land, which, after a specified number of years, they will return to the owner in bearing trees. In other cases, laborers, hired outright, work on the estate, buying nearly all the necessities through the land owners' stores. The productivity of an estate depends in considerable measure on the number of laborers attached to it (Fig. 138).

With this system of land ownership

and tenure, primitive methods persist and crop yields continue low. Only two areas in all the North Andean Region, the Valencia Basin and the Savanna de Bogotá, have improved methods and implements; even here only a few of the *haciendas* possess them. A crooked-stick for a plow, a hoe, and a machete are the universal tillage implements. A number of conditions preclude the use of modern machinery: remoteness from ocean ports, the difficulties of distribution within the region, an illiterate farming class, rough surface of most of the farm lands, absolutely precluding the use of machines, and the unwillingness of land owners to go to considerable expense introducing improved machines which would increase the idle hours of the estate laborers and result in the surplus of



FIGURE 137.—On only a few farms in the Savanna de Bogotá have pure bred stock been introduced. Where they are properly cared for they give good results in this temperate region.

a product that could not be marketed, owing to transport difficulties. Except for coffee culture in some areas, the agriculture suffers from other handicaps: lack of any seed selection, absence of crop rotation, no fertilization, ravages of insect pests and



FIGURE 138.—Valley of Rio Chama in Sierra Nevada de Merida. The temperate crop zone; patches of cereals, potatoes, and alfalfa in the middle distance; an excellent field of wheat in the foreground. Elevation 9,400 feet.

diseases, prevalent poor methods of tillage and preparation of products. From estate records, fields in the Pamplona Valley have been in cane for 40 years; others in the Cauca have grown cane for 80 years; in the Sa-

closed by a stone wall and winnowed by the breezes (Fig. 139).

In the animal industry poor methods also exist. Though most pastures are fenced with stone or barbed wire, young and old animals graze



FIGURE 139.—A fairly well plowed field in the level Savanna de Bogotá, an area of temperate crops and grazing. Throughout the North Andean Region most land is very poorly tilled, being only scratched with a crooked stick for a plow and drawn by oxen. (Courtesy of C. E. Cormany.)

vanna de Bogotá wheat has been planted on the same piece of land for 40 consecutive seasons without the employment of any fertilizer. Wheat sown broadcast and cut by hand with a sickle is tramped from the sheaves by oxen or mules on earthen floors en-

together, no attempt being made to regulate breeding. The fever tick is present in most areas; yet, dipping tanks are the exception rather than the rule. The warble does considerable damage; other diseases are endemic. Nowhere is milk treated and

delivered as certified. It is delivered in the cities by cup dipped from a can on the back of a burro or from a spigot of a can; the milk pails even on good farms, washed in the irrigation ditch or nearby streams, are seldom scalded.



FIGURE 140.—A modern dairy barn in the Savanna de Bogotá. The tall eucalyptus trees introduced about forty years ago are prominent features of the landscape.

Such conditions were observed as the common practice on a recent survey in many portions of the region (Fig. 140).

THE FUTURE

Most of the North Andean Region, permanently handicapped by an inland location and rugged relief, precluding the use of large modern machines in most areas, the region as a whole can advance materially along a number of lines with the improvement of transportation facilities, the rise of the farming class in education and standard of living, and the increase of immigration. Though the region produces excellent mild coffee, virgin lands planted to coffee, better

methods of pruning and preparation, and a study of methods of combating coffee diseases will enhance the position of the region in this product. Seed selection and plant breeding, improved methods of tillage, crop rotation, and fertilization are needed in connection with all other crops. Likewise, experiments in breeding the *orejo negro* with the Angus in the Antioquia Highland to produce a breed immune to the warble and the tick, and the native tick-immune longhorn cattle of the lowland with the Shorthorn or Hereford to improve the quality of the meat in the lower warmer regions. But, in the face of all inclinations towards improvement or better methods lie difficult transportation and vast permanent land holdings, tilled by a backward illiterate class that seems, in many ways, incapable of marked advance without a long period of evolution. These conditions will retard for decades agricultural development in the North Andean Region. (Fig. 141).

LLANOS GRAZING REGION

With an area of some 200,000 square miles, the Llanos Grazing Region is the principal grazing land of northern South America. Stretching from the Guaviare River on the southwest to the delta of the Orinoco on the east, the region has a remarkable uniformity in physical constitution and in human economy. It consists essentially of an expansive savanna devoted almost exclusively to the raising of cattle. Though one-third of the land lies in Colombia, from the standpoint of agriculture the *llanos*, or plains, of Venezuela far overshadow the more remote area to the south. Indeed, even explorers have rarely ventured south of the



FIGURE 141.—A scene on the Magdalena River showing bags of coffee ready for export, and illustrating the primitive and poor transportation facilities of part of the North Andean Crops and Grazing Region. (Courtesy of the Pan American Union.)

Meta River. Everywhere population is sparse, for these great plains do not conduce to an easy life and their one important industry demands relatively little labor. Access to various parts of the region is easy compared to the hardships of reaching sections of other portions of tropical South America. Both rivers and plains lend themselves to travel, but the land tends to repel large-scale settlement.

PHYSICAL CONDITIONS

The plains of the Orinoco basin composing the Llanos Grazing Region scarcely anywhere reach an elevation of 1,000 feet. Near the bordering mountains and highlands in the north and the southeast, the land rises into rolling hills, but on the average the *llanos* comprise an almost level surface of alluvial materials comparable in point of relief to many parts

of the Argentine Pampa. North of the Orinoco River a series of low sandstone mesas furnishes a major relief feature. Soils vary from coarse gravels on the mesas and near the mountains to fine silt loams and clays in the lower more distant portions of the plains. Impermeable clays underlie marshes in many areas, while in others sands and gravels cause droughtiness.

Whereas relief and soils tend to favor agricultural utilization, climate definitely limits possible development. Though the seasonal differences which have caused the establishment of savanna vegetation thereby favor grazing, at the same time they constitute the principal obstacles to the industry. While the annual rainfall averages between 30 and 50 inches in one season—"winter," April to October—floods threaten the region; in the other season—

"summer," November to March—the *llanos* thirst under a blazing sun. Warm throughout the year, in the dry season particularly, the plains experience terrific heat, slightly alleviated now and then by the persistent northeasterly trades (Fig. 142).

The drought of summer gives predominance to the widespread cover of tall coarse bunch grasses and establishes the savanna character of the region. The alluvial plains of the Apure River possess a more favorable stand of grasses and here has grown

In the Colombian *llanos*, forest products attain some commercial importance and comprise chiefly sarsaparilla and a small amount of rubber. In these southern plains, the more evenly distributed rains cause greater tree growth and a better cover of grass, but remoteness deters progress.

CATTLE-GRAZING INDUSTRY

At one time regarded as among the most valuable of potential grazing lands, the *llanos* have fallen far short of producing a great cattle industry.



FIGURE 142.—Characteristic vegetation of the Llanos with open savannas, bush and gallery-forests alternating. On the road from Ortiz to El Sombrero (Guárico). In the background "galeras"—hill ranges in the Central Llanos. (Courtesy of Peter Christ.)

the principal grazing district of the region. Only along water-courses and in rather large humid depressions to the west and north do trees find growth possible. Among the arborescent forms, two palms prove highly valuable to the native population. The northern plains have *Copernicia tectorum*; the south profits by its supply of *Mauritia flexuosa*. The former tree furnishes abundant material for thatching buildings, as well as for the making of straw-hats, the latter both thatching and construction supplies.

Moreover, there exists no immediate prospect for an approach to even moderately important development.

In general, the *llanos* offer many attractions for cattle-grazing for they are vast plains covered with grasses. In addition, the region lies nearer to Europe than Argentina by a full week. With the increasing need for crop land throughout the world, new grazing lands must be utilized, so that some degree of advance in the region is certain, but natural and imposed handicaps abound.

During the flood season, rising waters force the cattle to the swells, from which they soon remove the available grasses. Many perish in the attempt to reach areas where the grasses have not been grazed. With the recession of the floods, immense swamps remain for some time, breeding places for pestilential germs spreading disease and death among men and beasts. Later in the year begin the ravages by the tick. In a few months after the floods, the land becomes drier and under the warm, moisture-gathering trade winds, the

coast range to Barcelona and to Guanta is less difficult, but as yet the scarcity of fenced pastures hinders its rise. Large numbers of live cattle also leave the region by way of the Orinoco River, via Ciudad Bolívar or Barrancas.

While in addition to the foregoing hindrances labor is scarce and unskilled, possibly the most powerful of the obstacles barring the way to the industry lies in political conditions. In Venezuela where the industry has attained greatest proportions, grazing has suffered greatly from the political



FIGURE 143.—Llanos de Araure. The tall coarse grasses almost hide the two animals in the foreground. Gallery forests along streams. In the distance the southern ranges of the Northern Andes. (Courtesy of Ernest G. Holt)

plains soon experience a serious shortage of water. The grasses grow hard, dry, unpalatable, and unnutritious. Then only irrigated pastures of alfalfa or *Pará* or *Guinea* grass can supply the needed fodder (Fig. 143).

Transportation routes and facilities interpose additional difficulties. To reach markets, cattle must be driven long distances. The major outlet is that through the low pass in the coastal range to Puerto Cabello. A domestic monopoly of pasture land, at this point where cattle require fattening after the long trip, has effectually prevented the natural growth of foreign investment. The outlet through the gap in the low

vicissitudes in the country's history. Introduced from Andalusia by the *Conquistadores* in 1548, cattle were allowed to run wild; and in colonial times grazing held an importance far greater than that of the present. In eastern Colombia, the plains remained barren of cattle for several centuries. A class of semi-nomadic herdsmen appeared, the *llaneros*, under whose care the herds increased rapidly; by 1812, 4,500,000 head grazed the broad grasslands. The wars of independence decimated the ranks of *llaneros* as well as the herds and a notable decadence of the industry ensued; in 1823, approximately one-quarter million animals

remained. The surviving animals served as the nucleus for a period of growth interrupted, however, by a series of civil wars. In 1864 the *llanos* supported 6,000,000 cattle; 1873, 3,500,000; 1883, 8,600,000; 1901, 2,000,000; 1924, 3,000,000, generally of poor quality, and requiring a long period of improvement to fit them for active competition on world markets (Fig. 144.)

THE OUTLOOK

That the *llanos* face a near future brighter than their present condition is improbable. Foreign capitalists show a natural hesitancy towards investing the needed millions of dollars in an industry so liable to interruption by political influences. In recent years, the critical situation arising from the overemphasis of development in the Maracaibo oilfields has increased this disinclination to exploit the resources of the Llanos Grazing Region. Without capital, the handicaps of character of forage, and of flood, drought, pestilence, distance, and labor assure the prolonged unprogressiveness of the grazing industry in interior Venezuela and eastern Colombia.

THE GUIANAN LITTORAL

In the long narrow strip, extending from northwestern British Guiana to eastern French Guiana, lies one of the most productive agricultural regions of lowland tropical South America. Much of the wealth produced by the region may be ascribed to the favorability of certain natural conditions, but on the whole greater importance must be attached to the overcoming of certain unfavorable factors as the basis for Guianan wealth in sugar, coffee, cacao, rice, coconuts, and numerous minor prod-

ucts. In this connection, the Guianans, more notably the British and Dutch portions, owe much to their relations with the mother countries. Without the capital forthcoming from England, Holland, or France, the hot, humid, essentially swampy and unhealthful coastal strip composing the region would have remained simply a land to be avoided, a condition still holding in adjacent territory. As it is, however, the Guianan Littoral has experienced agricultural development over a period longer than for most parts of the continent.

The early interest of Europe in tropical lands, as potential sources of sugar primarily, gave the original impetus to agriculture in the region. On account of its adverse climate, the region had practically no indigenous labor supply. Hence the importation of labor began at an early date and from this immigration the bulk of the population and the chief features of agricultural production have arisen. For example, the East Indians, who now make up 42 per cent of the 300,000 people in British Guiana, not only furnish the labor for agriculture but they have installed rice as a leading commodity of domestic and foreign trade. With the Indians may be classed the second large population group, comprising the descendants of the African negro slaves who originally manned the sugar plantations.

In addition to its adaptability to sugar production, the Guianan Littoral profits by its proximity to Europe. Although this situation was a potent factor in the rise of the region, conditions of internal transportation, in contrast, have constituted a major hindrance. The narrowness of the agricultural belt



FIGURE 144.—The distribution of cattle in South America. In the northern portion of the continent a number of cattle grazing regions stand out strikingly. They include, the Bolívar Savanna, the Cauca Valley, the Savanna de Bogotá, and the vast Llanos of Venezuela. (From "Commerce of South America," C. F. Jones. Courtesy of Ginn & Company.)

reflects the primitive condition of communication with the forested interior. Only along the low coastal plain, across which flow myriad streams, and in the lower valleys of the principal rivers, does agriculture find commercial development possible. These lands, in many sections protected from inundation by dike systems introduced by the Dutch, are in the heart of the region, the point of origin of all progressive tendencies, and the only portion of the three colonies likely to undergo much agricultural progress for many years.

SURFACE OF THE LAND

Most of the cultivated land consists of flat, wet, alluvial coastal plain, in a belt of savannas, which requires constant drainage of waters brought by rains, rivers, and the sea. The soil materials of unconsolidated sands, clays, and humus have great depth. When properly drained and freed from its impregnation of salt, the characteristic clay or clay-loam is exceptionally fertile. Rising slowly towards the interior, the alluvial stretch grades into a zone of sand hills.

Though the levelness of the surface and the fertility of the soils favor tillage, problems of flood waters are serious. In addition to the frequent undesired inundations of plantations, the powerful major streams may destroy extensive tracts of cultivated land. On the other hand, by reason of their huge loads of sediment, the same streams contribute to the arable land. Each large river has numerous islands near its mouth, where mangrove and other semi-aquatic forms rapidly transform sand-bars into potential farming land.

CLIMATE

As in most of tropical South America, its climate distinctly handicaps the Guianan Littoral in its ability to attract immigrants. For its leading agricultural products, in contrast, climatic features prove highly suitable. Most of the region receives an annual rainfall of more than 80 inches, with a dry season over all the region occurring about the time of the September equinox. At times, droughts become sufficiently intense to damage crops, but in general the doldrum rains guarantee ample rainfall for crops at all times. High humidity and high temperatures make the climate uncomfortable to white men, although for parts of the year the northeasterly and southeasterly trades somewhat alleviate the enervating effects of the heat. At Georgetown a difference of only 2.3° F. obtains between mean monthly temperatures of the warmest and coldest months, while at Paramaribo and Cayenne the contrast in seasons is even less.

AGRICULTURAL PRODUCTS

The expenses of maintaining agricultural land on a large scale and the ease of producing a few provisions for home consumption make for a close dependence of the leading crops on external markets. Rice, next to sugar, the principal crop, holds first place as a foodstuff for the masses, and also provides a considerable quantity for export. The laboring classes supplement their important dish of rice with the yam, cassava, sweet potato, plantain, several indigenous legumes, and various vegetables like tomatoes, egg plants, and okra. In addition to sugar and rice, the major crops grown for export

embrace coconuts, coffee, cacao, and limes. British Guiana accounts for the bulk of agricultural production, Dutch Guiana for a substantial amount, and French Guiana for little except to maintain a domestic supply for its 44,000 inhabitants.

SUGAR CANE

Though sugar cane holds first rank among the crops as well as products in general of the Guianas, the industry has not prospered well for many years. Annual production averages 100,000 tons, of which British Guiana accounts for nine-tenths

tion: ample precipitation, abundant fertile land, excellent means of transport between field and mill by numerous drainage canals, and preferential tariffs (Fig. 145).

In return, much of the land comprising the estates lies below the level of high tide. Consequently, behind the natural barrier of *courida* or mangrove, a dam of earth must be constructed to form a further barrier against the sea. Next to the front dam comes a small strip of grasslands used for pasturing a few horses and cattle, intersected by either a public road or railway, on either side of



FIGURE 145.—Several factors favor cane production in the dyked lands of British Guiana. The three tall smoke stacks are those of a large *Central*. At the left the dyked gate is raised to let the water drain off of the low flat lands while the tide is out. At extreme low tide the gate is lowered to keep the water off the land.

on some 50,000 acres of land in cane, an area representing more than 40 per cent of the total land in crops in the country. The industry has had a long history in the region, succeeding cotton which prior to United States competition prevailed among the crops. The multitude of difficulties besetting cane production, however, have caused a constant decline in the number of plantations, though increased efficiency in technique has been effected at the same time. In 1825 in British Guiana there were more than 200 sugar estates; today there are less than 40. Dutch Guiana has four estates, Cayenne none.

Several factors favor cane produc-

tion: ample precipitation, abundant fertile land, excellent means of transport between field and mill by numerous drainage canals, and preferential tariffs (Fig. 145). In return, much of the land comprising the estates lies below the level of high tide. Consequently, behind the natural barrier of *courida* or mangrove, a dam of earth must be constructed to form a further barrier against the sea. Next to the front dam comes a small strip of grasslands used for pasturing a few horses and cattle, intersected by either a public road or railway, on either side of

which extends a canal; these fields are criss-crossed by numerous trenches. In many cases the area occupied by dams and trenches amounts to 10 per cent of the total area of the plantations, which extend back lengthwise from the river or sea in rectangular blocks, and an additional dam guards against floods from the land. The innumerable drains crossing the fields preclude the use of large machinery, a most unfortunate situation in a region suffering from a dearth of labor. Manual labor serves therefore for planting, cultivating, and harvesting. Furthermore, the industry has had to face declining prices and very effective competition.

As a result of efforts to meet com-

petition, modern methods of manufacturing are the rule. The majority of estates have from 1,000 to 2,000 acres under cultivation; the largest, on the Demerara River, has 7,200 acres annually, producing 12,000 tons of sugar. Each estate produces its own sugar and sugar by-products. Of the latter, rum is of considerable importance. Commonly, the planters obtain one direct and one ratoon crop. Following ten or more years of planting, the soil generally becomes exhausted. To restore the productivity of the soil fertilizers are rarely used. Instead, fields are flooded for six to twelve months, the land then is drained, and cropping begun again.

RICE

In the early 1870's, British Guiana had a yearly import of more than 30,000,000 pounds of rice. Today, the grain has proved so well adapted to the physical conditions of the coastal savannas, that it not only supplies all regional needs of Indians in Demerara and of Javanese in Surinam, but holds an important place in the British Guianan export movement.

Large areas of land possess the requisites of rice production: heavy rainfall, warm climate, good irrigation facilities, and excellent soils. Labor is not so serious a problem as in the case of sugar, since the rice is cultivated chiefly by the small farmers, and the East Indian feels at home in the rice fields. Many of the small farmers rent portions of abandoned sugar estates, in order to plant their rice on the flat, heavy lands which in the long years of cane cultivation have developed an almost impervious subsoil, an important factor in the cultivation of rice.

First introduced early in the eighteenth century, rice soon came to be cultivated in many districts, although on a small scale. Its excellent keeping qualities and its high yields created a demand for the grain, especially as a food for slaves. Up to 1886 the area given over to rice production remained small and lay in separated districts of the Essequibo, Mahaica, Abary, and Canje Rivers. At present, the principal areas lie on Wakenaam Island and on the coast from the Supenaam River to Hampton Court. Acreage averages some 30 per cent of land in crops.

Although most of the grain comes from small farms, large scale operations have begun. These resemble the methods in use on the machine-cultivated rice lands in the United States, and effect a decidedly worthwhile economy of labor.

MINOR PRODUCTS

Coconuts play an important part in the agricultural economy of the Guianan Littoral. In British Guiana alone, the trees grow on more than 30,000 acres. They flourish and bear prodigiously on sandy coastal soils, although frequently hurricanes lay waste over large areas. Also, the diked coastal lands lack the proper movement of ground water to insure the most healthy growth of the trees. Most of the nuts come from small estates and supply domestic requirements for coconut oil and cattle feed, the former of which is consumed in great quantities by the East Indians.

At one time in the 1830's, Demerara exported 10,000,000 pounds of coffee per year. The berry was of excellent quality, but the destruction of a labor supply by the emancipation

of slaves caused the decline resulting in a production barely sufficient for local demand. In Surinam cultivation of coffee is of far more significance at present than in the western colony, annual production totalling some five and one-half million pounds, and the crop ranking second to sugar. Liberian coffee predominates among varieties.

Additional crops include cacao of excellent quality which may be grown in many areas on the lower reaches of the rivers, where protection from winds may be had, and

tures are flooded, cattle often grazing more than knee-deep in the water; and in the dry season frequent shortage of palatable water occurs. Cattle shipped in from the *Llanos* compete in the markets of the coastal districts with cattle from the nearby savannas (Fig. 146).

THE FUTURE

The prospects for any widespread advance in the agriculture of the Guianan Littoral are limited. While the region possesses large areas of potentially arable land, both within



FIGURE 146.—The Coastal Savannas of British Guiana only a short distance back of the sea wall. These flat low lands, though providing fairly good pastures are of little use agriculturally unless well drained.

where proper drainage is provided. Production is restricted, because of lack of capital in British Guiana and the ravages of the witches-broom disease in all areas. Somewhat more than 1,000 acres of limes also engage the attention of producers in the Guianan Littoral and now produce more by value than cacao.

The raising of livestock claims little attention in the Guianan Littoral. Large areas of the coastal savannas can support cattle and a few animals do graze the grasses. Most of the cattle are highly mixed, a goodly percentage having *zebu* blood. Water supply raises the chief obstacle, for in the rainy season pas-

its borders and available farther inland, the necessary urge to develop them will not come for a long time. The existing régime of an agricultural system based on sugar as a mainstay has supported the land for almost a century, but today even under the stimulus of notable tariff preferences the industry has a hard row to hoe. Crop diversification may increase the area of land in crops and thereby production, but the region has always to contend with the problems of its climate with regard to population. Furthermore, sugar, rice, coconuts, coffee, cacao, and limes are grown in a large nearby and highly competitive zone. Hence

capital tends to refrain from development of these less favorable lands. The principal expansion of agriculture must come from the adjustment to natural increase in population, as well as possible changes dependent upon mineral exploitation, and from the growth in numbers of the small farmer.

THE GUIANAN FOREST AND GRAZING REGION

Notwithstanding an area greater than that of Chile, the Guianan Forest and Grazing Region has a total population among the smallest of the agricultural regions of South America. Considerably more than 200,000 square miles of its territory has a density of population of less than one-fourth person per square mile. Little is known of the region except about its margins, interest in its resources does not develop much importance, and the great handicaps inherent in an isolated, largely heavily forested tropical region guarantee the maintenance of this situation.

Human activities that have arisen could do so only by overcoming or modifying the effects of a practically non-existent system of communication. Forest industries operate where access to a stream may be had; grazing has arisen in the interior solely because cattle furnish their own transportation when, and if, necessary; and tillage of the soil occurs in tiny patches along stream courses or near the several mining enterprises. The exploitation of minerals, in particular, has served to establish certain of the agricultural industries, in that the search for gold or diamonds leads men on into the districts commonly regarded, from an economic standpoint, as practically unattainable at present.

To the native Indian somewhere in the vast protecting forests, the outside world represents an unknown quantity. The forests provide food, shelter, and opportunity for crop culture sufficient for his limited needs. Only about the margins, where collecting and distributing points have grown, do relatively large centers arise. Such are the Orinoco part of Ciudad Bolívar, which serves most of the Llanos and practically all of Venezuelan Guiana, and has a population of 20,000; Georgetown, also a strategic commercial, as well as administrative, center, having access to the sea and to two principal rivers in British Guiana, with a population of 55,000; Paramaribo, on the Surinam River, and Cayenne on the Cayenne River, each bearing the same relationship to its country as Georgetown, and having populations of 40,000 and 15,000 respectively.

PHYSICAL SETTING

Though with regard to degree of development, the region exhibits a uniform aspect, the various natural elements show considerable diversity. The implications of the two distinct occupations—forestal and pastoral—suggest a basic set of major differences.

Rising from sea-level, at the delta of the Orinoco River, to an altitude of 8,600 feet in the giant tablemountain of Roraima, at the Venezuela-Brazil-British Guiana boundary, the region has considerable variation in land features. In general, however, that portion south of the Orinoco may be designated a plateau of moderate relief, though deeply seamed in many places by many torrents. The highest lands are tabular, frequently barren, sandstone areas,

about which lie extensive crystalline surfaces of irregular relief, here and there capped by volcanics. To west, north, and east, the region grades into the alluvia of Rio Branco, Orinoco, and coastal plain districts respectively. The sandstone districts have occasioned much of the savanna land in the region, while the soils weathered from the granites, gneisses, and diabase support a usually dense stand of forest (Fig. 147).

lies clothed in a heavy forest of significant value. The sands and clays of the peripheral lands in the Guianas, the gray alluvia of the Orinoco delta, and the Southeast in the Venezuelan territory of Amazonas support the most luxuriant growths. In most respects—profusion of species of trees, epiphytes, leaves and undergrowth, and economic utility—they resemble the Amazonian forest. The principal

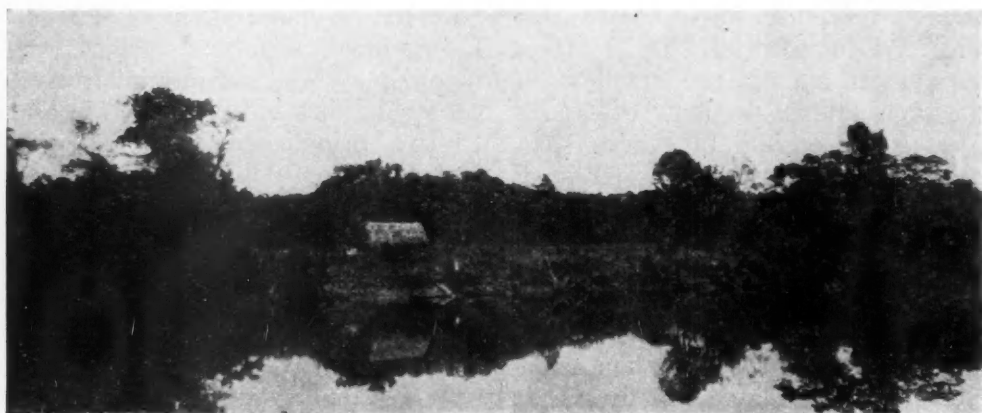


FIGURE 147.—A small clearing in the greenheart forest region along the Demerara River. In these forest clearings a little primitive agriculture is practised by the native population. The soils being sandy or sandy loams leach very rapidly under the method of cultivation.

Most of the region is hot and humid, with an annual rainfall of between 40 and more than 80 inches, the totals for the Guiana colonies, in general, far exceeding those for Venezuelan Guiana. Near the east-west portion of the Orinoco and about the headwaters of the Rio Branco, flowing to the Rio Negro and the Amazon, and about those of the Rupununi River, flowing into the Essequibo, a broad divergence in seasonal totals accounts in part for the savannas of those areas. Owing largely to their elevation, the savannas also are cooler and more healthful than the contiguous lands.

By far the larger part of the region

forest industries, however, here depend upon resources different from those employed in the region to the south, but the difficulties of exploitation remain essentially the same. The savannas cover extensive tracts, but lack of population and transportation facilities prevent important development.

FOREST INDUSTRIES

In its proximity to the sea the Guiana Forest and Grazing Region enjoys a great advantage over the Region of Amazonian Forest and Primitive Agriculture. Many of the streams which flow through the forests are navigable to the sea, though

for only short distances. Hence, timbers provide for a major industry, but here, too, a form of rubber—*balata*—claims greatest attention.

Balata (from *Mimusops globosa*) is the principal forest product of Venezuela and of the three Guianas. The tree occurs in scattered solitary specimens or groves throughout most of the forested area, but the principal producing districts are those of Tumeremo, in Venezuela, to the south-east of Ciudad Bolívar, and in the Amazona territory. The crudity of methods used in tapping has wiped out the industry in many areas but a realization of the value of this resource has prompted the enactment of strict regulative measures over all of the region, enforcement of which necessarily leaves much to be desired.

Timbers provide the second forest industry of importance, and include a large number of useful species. The Guianan portions carry on most of the activity, owing to the accessibility of the forests and the proximity to a large local market as well as to facilities for shipment abroad. Though much of the forested area lies in inaccessible places, the utility of the Guianan stand ranks it among the most valuable of South American sources of timber. Of the trees, the greenheart (*Nectandra rodioei*) has the greatest value and is exported only by British Guiana. Its exceedingly durable wood is much sought for use in constructions. Owing to the great specific gravity, the logs are braced on the outside of large punts by means of the abundant creepers and floated to market. The mora (*Dimorphandra mora*), also having extremely hard resistant wood, of considerable economic importance, is a second form of great value.

Softer woods including crabwood (*Carapa guianensis*) and wallaba (*Eperus sp.*) have a greater stand than the hardwoods and supply far more lumber. The wallaba, most abundant of timbers in the commercially developed forests of the east, composes 40 per cent of the total forest wherever it grows. The western forests, because of their remoteness, yield little timber, only a few logs of cedar (*Cedrela odorata*) going downstream for export from Ciudad Bolívar to Trinidad (Fig. 148).

The tonka bean, the extract of which is an important perfume base, leaves the region in large quantities, chiefly via Ciudad Bolívar. The tree (*Dipteryx odorata*) grows especially well in the north, in the valleys of the Coura and Cuchivero Rivers, near the Orinoco.

The forest exercises a profound influence over the life of the native. Not only does it provide labor through the year—gathering of *balata* and rubber comes in the wet season, of tonka beans in the dry season—but it also affords food, clothing, and shelter. On the delta of the Orinoco the close dependence on the forest is noteworthy. Here a single tree, the *morihe* palm (*Mauritia flexusca*), furnishes most of the living requirements for entire tribes—trunks and leaves for buildings, fibers for weaving, shoots, fruit, sap, and pulp for food. In other districts, clearings in the forest produce greater variety in diet, chiefly with the raising of *yuccas*, cassava, sugar cane, plantains, bananas, and some corn.

GRAZING

Though the region embraces extensive areas of savanna, grazing progresses slowly because of the lack of transportation facilities. The

major activity has centered in the lands about the Río Branco, whence the principal products—hides and skins and live animals—descend the streams in barges to Manaos. The Rupununi savannas of British Guiana have a few thousand cattle, but as yet they await the magic touch of a railroad or through highways to the coast.

THE FUTURE

Means of transportation condition all development in the Guianan

REGION OF AMAZONIAN FOREST AND PRIMITIVE AGRICULTURE

During the period of its "hey-day," the Region of Amazonian Forest and Primitive Agriculture attracted more attention from the world than any other part of South America. Today it lies a vast area, of little development, and promising little change for many years. Its far-flung domain leads the world in several respects, such as extent of tropical forests, proportions of drainage systems, and the like, but with



FIGURE 148.—In the greenheart forest region along the Demerara River. A log raft being taken down the Demerara to Georgetown.

Forest and Grazing Region. As in other tropical lands, though the climate may be unhealthful, a certain amount of labor is available, but without access to ocean-shipping, little may be accomplished. The high-priced commodities, such as balata, rubber, and tonka beans, pay their way, but the major resources represented by the timbers will come into greater use only gradually. As yet, savannas and grazing have negligible significance and can acquire little until the more productive natural wealth in the forests lose attractiveness—a matter of the far distant future.

respect to actual tangible significance to Brazil, or to the world, at present the importance of this extensive lowland greatly decreases. With an eye to potentialities ascribed to tropical lowlands, none of the several countries sharing this region evinces any desire to relinquish its holdings. Commercial developments indicate that these lands, heavily timbered in large part and so handicapping human use, and capable of producing few of the major foodstuffs of the world in an appreciable quantity, can undergo only a slow evolution before achieving a permanent importance commensurate with their size.

The vastness of the region militates against rapid exploitation. Hundreds of thousands of square miles lie virtually barren of even primitive Indian settlement, not only because of the unhealthful climate, but also as a result of the great distances to sources of supply and the difficulty of traversing those forested and commonly swampy distances. Such products as do originate here reach markets chiefly because of their ability to overcome the handicaps of difficult transport, either as a result of high unit value or cheapness of exploitation. Thus do rubber, Brazil nuts, cacao, timbers, and many minor forest products enter trade channels. Essential food crops and livestock have little importance other than a local one. In no case is the high unit value or cheapness of exploitation attributable directly to development by man. Here there has occurred no change comparable to the improvement of cattle-grazing in Argentina or to the growth of the *yerba maté* industry in the Subtropical and *Yerba Maté* Forest.

Minus the magnificent system of navigable waters afforded by the Amazon and its tributaries, the region would find its size fatal to exploitation. On the other hand, because of these great fluvial highways, Manáos, at a distance of more than 1,000 miles from the sea has 75,000 people and is the seaport for possibly one million square miles, while at the mouth of the great system, Pará has a population of more than 225,000. The high percentage of foodstuffs among goods imported at these points denotes further the low stage of agricultural development of the region. Railroads have little influence on the reduction of transportation costs of both imports and exports.

The region has only a few hundred miles of expensive line, the longest of which, that paralleling the rapids of the Madeira and Mamoré Rivers for 226 miles, finds operating costs too great to permit much growth in traffic.

PHYSICAL CONDITIONS

Despite the size of the region, a most notable feature is the uniformity of physical conditions. In general, this is a great basin of comparatively little relief, forested almost entirely, and under the influence of a tropical humid climate. Though it embraces 1,800 miles in extent from north to south and 2,500 miles from west to east, practically all of the region has an elevation of less than 1,000 feet and easily one-half of this area lies under 500 feet. Were this expanse to have a situation like that of the Central Plains of North America, its lack of great relief would make it one of the great producing areas of the world; but a true tropical climate, with its concomitants of rain forest and tropical soils, gives the Region of Amazonia Forest and Primitive Agriculture its predominantly backward aspect.

CLIMATE

This region is the world's largest continuous territory having that climate most commonly associated with equatorial latitudes. Temperatures average high throughout the year and daily range exceeds seasonal range so that night constitutes the winter of the land. At Manáos November has the highest mean monthly temperature with 81° F., March, the lowest, with 78° F. The monotonous continuity of the great warmth, coupled with the high relative humidity, is especially detrimental to human initiative. The native in his



FIGURE 149.—Palm forest on Rio Itapicurú, near Caxias Maranhao; on the border zone between the Campos grazing region and the Amazonian forest. (Courtesy of Ernest G. Holt.)

original state can easily produce a sufficient store of foodstuffs with the result that apathetic indolence is a normal characteristic. Little need exists for the production of large quantities of supplies as a protection against possible famine in a poor season.

The rains have an important part in distinguishing the region from neighboring areas. Almost all of the land receives more than 60 inches per year falling generally in heavy downpours, the distribution of which accounts for the principal differences in climate and utilization of land among various sections of the region. The far west is conspicuously the wettest portion with annual totals approaching 125 inches. Practically every week brings drenching rains, though about the time of the June solstice a less rainy season holds sway. East of the Rio Negro-Amazon confluence rains decrease considerably and the drier season from June to November brings sufficiently dry conditions to favor relatively large tracts of savanna.

VEGETATION

For present-day purposes, the vegetation of the region provides its

most valuable natural resource and has done so since earliest days of exploitation by white men. At the same time, the great tropical rain forests are the major obstacle in the path of progressive development for the region, because of the difficulty of travel (Fig. 149).

Covering almost all of the region, the forest mantle contains an astonishing number of species. With the more valuable of these, the economic history of the Amazon Valley has been closely identified. Even granted adequate means of transportation exploitation proves difficult, owing to the scattered occurrence of the trees, the tangles of creepers and underbrush, and in the case of timbers a specific gravity in many cases greater than that of water. Nevertheless, profits are great enough to promise the continued dominance of forest industries in this region for many decades.

Aside from the distinction between the savannas of the north and that in eastern Marajó Island and the forest formation, the major groups of plants are divided on the basis of height above the rivers. The mangrove thickets about the mouths of the Amazon are especially well-de-



FIGURE 150.—Tall Brazil nut trees rising above the rather dense undergrowth on the Rio Tacontines near the southern border of the Amazon Region. (Courtesy of Ernest G. Holt.)

veloped, giving way to a tidal low-land forest a short distance inland. Upstream, the alluvial plain or *varzea* in places had large trails of grassland, but westward particularly it supports a dense growth of medium height. Here grow two of the most valuable trees of the region, the *seringueira* (*Hevea brasiliensis*) the principal source of rubber, and the cacao (*Theobroma cacao*). Above the flood zone, the forest attains its greatest variety and includes the important Brazil-nut tree (*Bertholletia excelsa*) and the *caucho* (*Castilloa elastica*). Here, also, originate the harder timbers (Fig. 150).

RELIEF AND SOILS

The vast lowlands composing the bulk of the region consist of three types of terrane, all of gentle relief and in that respect eminently suitable to the mechanical requirements of machine agriculture. Comprising approximately one-tenth of the total area, the alluvial districts, generally swampy, include comparatively narrow strips along the rivers. Though most of these lands have heavy dark soils of poor drainage, in some districts well-drained loams of high productivity border at the river

banks. The latter are the principal crop-producing soils of the region. The upland plains of two types—lower, near the rivers, and upper, over the rest of the region—are fairly well-dissected and well-drained areas. Soils average moderately heavy, but have a strikingly friable structure. Their productivity is high, but short-lived without the aid of artificial fertilizers.

PRODUCTS

For the region as a whole the cultivation of crops and the grazing of livestock are subsidiary to the forest industries. Concentrations of tilled lands or of livestock owe their origin primarily to the needs of laborers in the forests. About Pará, at the mouth of the Amazon, has grown the leading agricultural district, from which products go to all parts of the region. Other important producing areas lie about Obidos, Manáos, Iquitos, and in the Acre territory.

RUBBER

For many years, rubber constituted the sole barometer of economic activity in the region. The bonanza of "black gold" stimulated the land

to feverish exploitation of its great resources in the valuable latex. For more than thirty years rubber created millionaires in Brazil. Collecting of the latex began in the 1870's on the islands at the mouth of the Amazon and in the 1880's in the more important Acre district. Labor for the former came from Pará, while a series of drought years sent thousands of people from Ceará to the western rubber lands. With the unwise imposition of heavy export duties, the producing states gave foreign competition by plantation rubber, a great opportunity and paved the way for the crisis which has led to the present low status of the Amazonian industry.

The *seringueira* (*Hevea brasiliensis*), by far the principal rubber-producing species of Brazil, growing chiefly in the zone of the Purús, Juruá, and Acre rivers, as well as about the mouths of the Amazon, has served as the basis for the Brazilian rubber industry. The tree's usual habitat is the lowlands, humid or recurrently inundated. Hence, tapping occurs in the drier season and is accomplished by making incisions in the trunk. The rubber obtained excels all others in quality and is the "Para" or "fine" rubber of commerce (Fig. 151).

Caucho, derived from *Castilloa elastica*, is inferior to *Hevea* rubber and comes from the dry uplands. The tree grows in the upper basin of the Yavary, Juruá, and Purús Rivers and also on the higher lands to the north and south of the lower Amazon. Methods of exploitation are ruthless, consisting of cutting down the trees, and have resulted in virtual extermination of the species in Bolivia and Peru.

Though the rubber industry

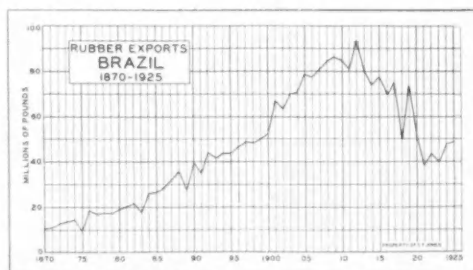


FIGURE 151.—Brazil supplied the world with rubber until the opening of the twentieth century. Increasing shipments of plantation rubber from the Middle East after 1900 and the heavy export tax on wild rubber from Brazil (amounting to as much as one-third its market value in some years) brought on the crisis in the industry from which it has never recovered and probably never will.

showed signs of recovery following the recent restriction on imports of British rubber by the United States, any large-scale development based on methods now in vogue in the region is impossible. The huge success of plantation rubber points to this type of production as the logical procedure. Though the Amazon lands, as the original home of *Hevea*, provide many favoring natural conditions, to attain a great plantation industry many handicaps must be overcome. These include: scant and inefficient labor, lack of governmental integrity and in consequence lack of capital, transportation costs, and the momentum already acquired by Far East plantations.

BRAZIL NUTS

In the diversification of occupations following the collapse of rubber, gathering of the Brazil nut has received greatest attention, so that this industry has become second to rubber among forest activities in the region. Production centers about Manáos and Pará, where the tree, the *castanheiro*, flourishes on the well-drained uplands. The industry has considerable promise, though as yet markets are small. Since only the

fruit of the tree is used, collecting of the fallen capsules containing fifteen to thirty nuts does not direct harm to this resource. Moreover, the tree is widely and abundantly dispersed. The nut has high food value and the natives consume it in quantities.

MINOR FOREST INDUSTRIES

Despite the enormous extent of forests, the lumber industry has reached only small proportions and in all probability never will become an important branch of activity in the region. As in all tropical regions, most of the timber is extremely hard, has high specific gravity (rafts of light woods are required to float many timbers), and lacks pure stands. In addition, the forests lie remote from centers of population and efficient means of transportation.

Certain woods already have acquired a market, but growth continues slowly. Cabinet woods of quality include a number of varieties, but a soft-wood—known as the “cedar”—is cut in greatest volume as a result of its occurrence near the rivers. Since the “cedar” has both Paraná pine and United States yellow pine with which to compete, its markets are limited.

The diversity of plant life has led to a number of small-scale commercial industries, which have far less importance than lumbering. These include principally the gathering of *balata* and of many kinds of oil-producing seeds.

CULTIVATED CROPS

The wealth of forest foodstuffs and the effect of comparatively high wages to be gained by gathering rubber have prevented much agricultural development. Practically all production goes to local markets or is

part of a subsistence agriculture. Sugar cane, cacao, cassava, corn, rice, and various fruits supply the bulk of necessities; of these corn occupies the largest acreage. Extremely crude methods prevail. For nearly all crops, the district about the large market at Pará has the greatest acreage. The potentialities for expansion in the production of sugar, cacao, and cotton are great and the continued diversification of industries will cause considerable though slow growth. Amazon cacao at one time supplied all of the world's trade in that commodity, only to decline with the rise of rubber and with the onset of numerous difficulties involving disease, floods, poor methods, taxes, and extra-regional competition. Today the chief centers of production lie between Manaus and Obidos and about the mouth of the Tocantins, and occupy parts of the alluvial plains.

LIVESTOCK

The grazing of cattle has considerable significance on the island of Marajá where more than one-half a million head live on the frequently flooded pastures. Minor grazing lands lie in the savannas to the north of the estuary, and in several alluvial plain grasslands. Though the grasses are neither particularly palatable nor nutritious, beef of fair quality is produced for markets solely within the region; encumbered with tropical diseases, insect pests, and low-grade animals, the cattle industry of these far-away savannas can experience little development until more temperate pastures of the continent have been utilized.

THE OUTLOOK

Although thousands of square miles in this region remain unex-

plored, enough is known of the areas as a whole to indicate no great progress in the near future. A debilitating climate, hostile to white settlement; pestilence; great distances traversed only with utmost difficulty; scant peopling; agricultural possibilities limited as yet to products more easily obtained in other parts of the world; these factors will maintain the comparative insignificance of the vast plains of eastern Colombia, Ecuador, Peru, and Bolivia, and the great interior of Brazil. To attain

great world importance the region has far to go. The mishandling of its valuable resources has set the land back many years. Only highly improbable efforts of titanic proportions can restore rubber to its former rank in world commerce. Cacao, also, has a long uphill struggle ahead. Diversification now under way in many parts promises much, but all evidence points to a long continuance of Amazonia's status as the largest and one of the least productive agricultural regions of South America and of the world.

THE POTATO INDUSTRY IN NEBRASKA

Esther S. Anderson

Geographer, University of Nebraska

DURING the last decade potatoes have ranked fourth in value of all crops in Nebraska, being surpassed only by corn, wheat, and tame hay. When a crop reaches the importance in the agricultural scheme of a state that the potato now holds in Nebraska, it merits serious attention. This article summarizes the results of a series of investigations made to determine what factors, environmental and economic, have been instrumental in promoting the development of the potato industry of the state.

REGIONS OF PRODUCTION

Although potatoes are grown throughout the state, Nebraska has three leading regions of production; namely, the western, central, and north central (Fig. 1). The western region is the heaviest producing area of both certified seed and table stock. An average of 46 per cent of the total crop in the state was grown in this region during the past nine years. The central region, located in the Platte Valley in Buffalo County and vicinity, is the chief source of potatoes for the markets in eastern Nebraska in late July, August, and September. The north central region, chiefly Brown County, supplies potatoes in the period intervening between those of the early crop of the central region and the ones of the late season in western Nebraska.

ENVIRONMENTAL FACTORS AFFECTING POTATO PRODUCTION

It is generally recognized that climate and soil are the principal

natural factors in potato production. The yield is heaviest where the average temperature is 64° to 70° F. during the growing season and where there are practically no hot days. This temperature range is prevalent in June, July, August, and September (the growing season) in the western region of Nebraska, thus satisfying the thermal optimum (Fig. 2). July and August temperatures in the central and eastern parts of the state are usually higher because the altitude is lower than that of the western part. However, potatoes are successfully produced in these areas because they are planted earlier in the season when the temperature is lower and hence they are ready for the market before the advent of the high temperatures of July and August.

Although the annual precipitation increases from only 15 inches in the western part of the state to 32 inches in the eastern part, the summer rainfall is generally ample in all areas for potatoes because they grow quite successfully in areas having 8 inches of moisture during the growing season. Inasmuch as normally all parts of the state receive more than 8 inches during this season, the moisture conditions are adequate for good crops.

RESPONSE OF POTATO PRODUCTION TO CLIMATIC CONDITIONS

The climatic conditions of western Nebraska are comparable with those of the more northern potato-producing states—Minnesota, Wisconsin, and Michigan—insofar as the length

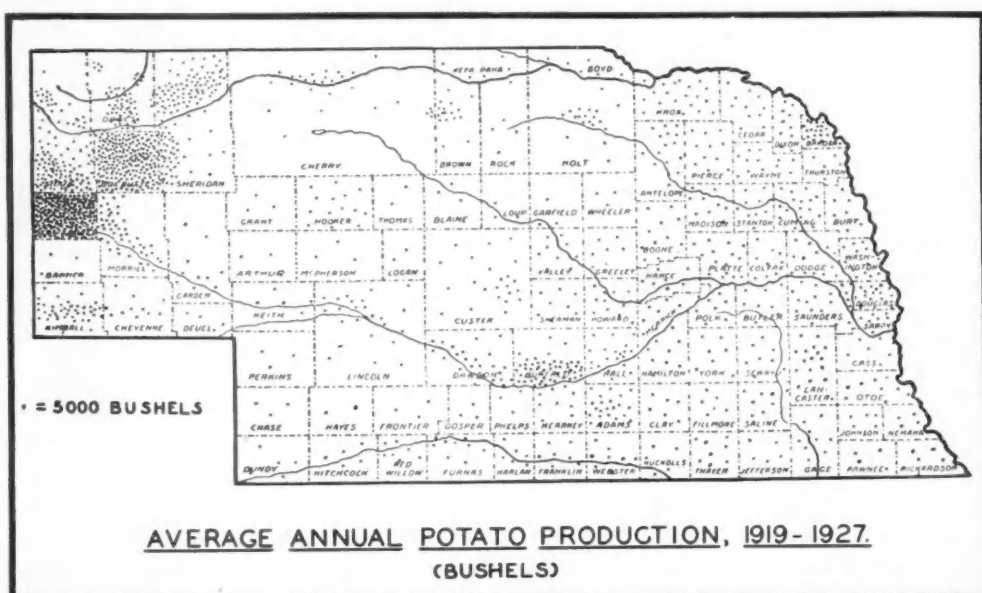


FIGURE 1.—An average annual production of 7,903,000 bushels of potatoes in Nebraska were produced from 96,000 acres, during the period 1917-1927. The western region of Nebraska is the principal producing area of both certified seed potatoes and table stock while central and eastern Nebraska are sources of domestic supplies. (Based upon statistics by Nebraska State Board of Agriculture, Lincoln.)

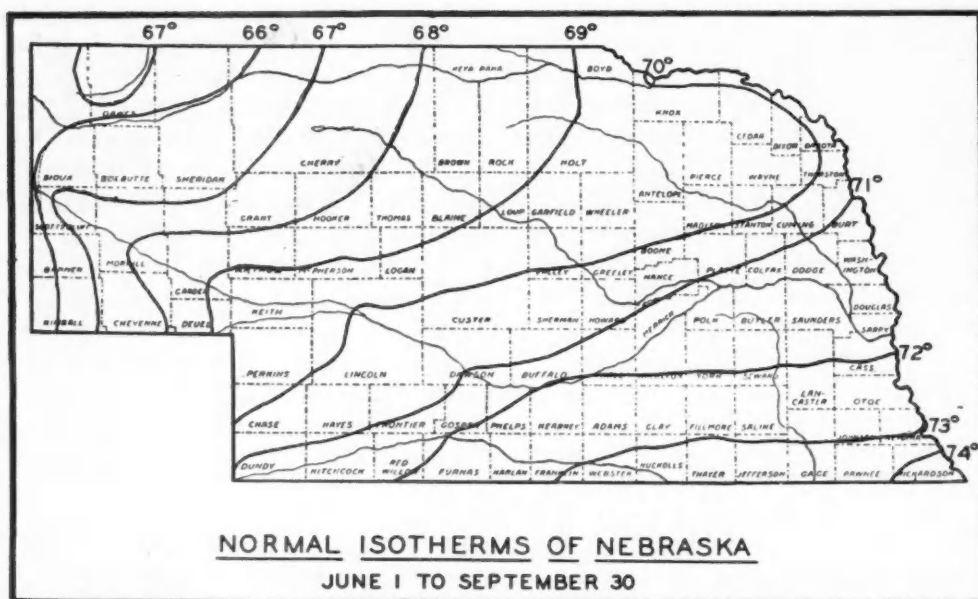


FIGURE 2.—Normal isotherms of Nebraska for the late potato crop season based on temperature records taken at U. S. Weather Bureau observation stations for a period of ten years or more. (After Werner.) The best potato crops are produced in the regions having a seasonal temperature from 66° to 68° F., and with practically no hot days nor temperatures exceeding 72° F. in July or August in western Nebraska.

of the growing season and its mean temperature are concerned.

WESTERN REGION

Although western Nebraska lies in a lower latitude than these states do, a growing season with a mean temperature of 66° to 68° F. exists because of the high altitude, 3,500 to 5,000 feet, which is important in causing a lower temperature (Fig. 2).

The western potato-producing region may be divided into (1) the

Sheridan—are north of the summer isotherm of 67° F.

The average yield per acre in the dry land section of this district shows a close relation to the temperature and rainfall during the years 1917–1927 (Fig. 4 and Table 1).

The correlation of the mean summer temperature and the production per acre show that the yields have been highest during the years in which the optimum temperature of 65° to 67° F. prevailed and when the



FIGURE 3.—A field of potatoes at the period of blooming near Marsland, Dawes County, Nebraska. This is a typical summer scene in the dry land certified potato-producing region. The fields vary from approximately one hundred to many hundreds of acres. (Courtesy of Conservation and Survey Dept., University of Nebraska.)

northwestern district which lies north of the North Platte River to South Dakota, and (2) the western district which includes the North Platte and Lodge Pole valleys and the table lands of the state south to the Colorado line (Fig. 3).

Northwestern District

In the northwestern district four of the leading potato-yielding counties—Box Butte, Sioux, Dawes, and

July temperature was not higher than 72° F., 1917 excepted. In that year the July temperature was 74.35° F., but the rainfall was low causing a retardation of plant growth. This was followed by a cool August and September together with a heavier rainfall, which were favorable conditions for a rapid growth and maturity of the crop.

The importance of rainfall during the period, 1917–1927, is indicated

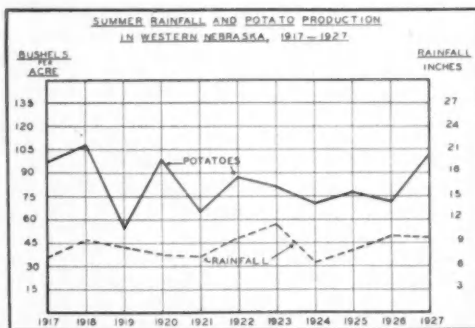


FIGURE 4.—The fluctuations in the average yield per acre in the dry land section of the northwestern district show a fairly close relation to the summer rainfall during the years 1917-1927. (Based upon U. S. Weather Bureau reports, and statistics by Nebraska State Board of Agriculture, Lincoln.)

by the fluctuations in the yields per acre which correspond closely to the variations in seasonal rainfall, except in 1921 and 1927. The de-

Although the summer rainfall was less in 1927 than in 1926, the yield per acre was 104 bushels, or the second highest during the decade. This was the result of a uniform mean summer temperature of 65.12° , the lowest during the period, and an evenly distributed seasonal rainfall of 9 inches. The highest yield per acre was 114 bushels in 1918 when the mean summer temperature was 67.07° F. and the rainfall exceeded 2 inches during each of the summer months.

Four of the five years having low yields per acre, had July or August temperatures above 73° F. In the past eleven years the highest summer temperature, the maximum July temperature, the minimum

TABLE I
AVERAGE TEMPERATURE AND RAINFALL, JUNE TO SEPTEMBER, AND THE AVERAGE YIELD PER ACRE IN THE NORTHWESTERN CLIMATIC DISTRICT OF NEBRASKA, 1917-1927

Month	Temperature (Fahrenheit) *										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
June	63.31	70.01	68.36	64.27	70.03	68.02	65.9	63.45	65.39	64.88	63.06
July	74.35	71.58	75.3	72.05	73.65	69.22	74.19	69.72	72.24	72.73	70.22
August	67.38	70.01	72.09	68.35	70.21	74.12	67.58	70.82	70.91	70.97	66.52
September	61.84	56.68	65.16	61.59	61.17	65.11	61.16	58.58	63.15	57.39	60.71
Average	66.72	67.07	70.23	66.71	68.76	69.12	67.21	65.64	67.92	66.49	65.12
Month	Rainfall (Inches) *										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
June	2.10	1.5	2.22	3.13	2.56	3.15	4.24	5.32	5.36	2.5	3.82
July	.98	3.0	2.67	1.71	3.49	4.56	3.56	2.31	3.11	2.58	2.09
August	1.02	2.22	.86	2.25	2.26	1.64	4.25	1.85	2.51	3.52	2.18
September	1.84	2.22	1.67	.96	1.72	.82	2.34	1.50	1.16	1.34	1.01
Total	5.94	8.94	7.42	8.05	10.03	10.17	14.39	10.98	12.14	9.94	9.10
Annual	15.93	19.17	18.85	26.11	19.71	22.53	25.50	20.05	20.43	18.09	23.17
Yield per Acre (Bushels) †											
County	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Cherry	90	117	45	85	71	77	79	52	77	75	92
Sheridan	125	120	40	91	86	81	73	47	105	92	106
Dawes	96	119	51	94	86	76	79	56	106	89	109
Sioux	118	103	120	147	145	112	110	105	140	153	149
Box Butte	85	111	48	91	80	50	80	46	95	90	107
Average	102	114	61	102	94	79	84	61	105	100	113
Average‡ without Sioux Co.	99	117	46	90	81	71	78	50	96	86	104

* Data compiled from reports of the United States Weather Bureau and cooperative stations at eleven places.

† "Nebraska Agricultural Statistics," Nebraska State Board of Agriculture at Lincoln, Nebraska and the United States Department of Agriculture.

‡ Much of the potato crop in Sioux County is produced under irrigation.

creased yield in 1921 was caused by a warm July and August and a relatively high precipitation, which were favorable conditions for a large amount of the disease, *fusarium wilt* or "stem-end rot."

yield per acre and the second lowest seasonal rainfall occurred in 1919. The July and August temperatures averaged 74° F. and the seasonal rainfall was 7.42 inches. August, a critical month in the maturity of

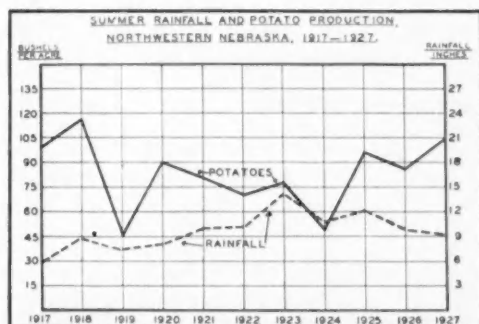


FIGURE 5.—The yearly variations in the production of potatoes per acre in the non-irrigated counties of the western district correspond quite generally to the summer rainfall but not as clearly as do those in the northwestern district. (Based upon U. S. Weather Bureau reports, and statistics by Nebraska State Board of Agriculture, Lincoln.)

potatoes, had only .86 inches of moisture. These unusually high temperatures and the lower rain-

Western District

The yearly variations in the yield of potatoes per acre in the non-irrigated counties of the western district correspond closely to those of the northwestern district. However, the average summer temperatures and the July and August temperatures in the former were usually higher than those in the latter while the seasonal rainfall was generally less; consequently, a slightly lower yield per acre prevailed in the western district (Figs. 4 and 5 and Tables 1 and 2).

During the eleven-year period, 1917-1927, there were two years, 1920 and 1927, in which the decrease in summer rainfall was accompanied by an increase in the yield per acre

TABLE 2
AVERAGE TEMPERATURE AND TOTAL RAINFALL, JUNE TO SEPTEMBER, AND THE AVERAGE YIELD PER ACRE IN THE WESTERN CLIMATIC DISTRICT OF NEBRASKA, 1917-1927

Month	Temperature (Fahrenheit) *										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
June	64.49	72.58	68.14	66.49	70.05	70.40	66.92	66.54	67.82	66.23	64.31
July	74.04	72.49	76.11	72.95	75.27	71.52	74.94	71.34	73.76	72.44	71.16
August	67.86	71.22	72.37	60.93	72.13	75.52	68.37	72.36	70.68	73.01	66.6
September	62.65	58.26	66.02	62.23	63.20	56.38	62.09	59.31	63.75	59.85	60.25
Average	67.26	68.63	70.66	65.65	70.16	68.45	68.08	67.39	69.00	65.25	65.56
	Rainfall (Inches) *										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
June	2.15	1.20	3.57	2.13	2.22	1.58	3.44	1.54	3.14	2.5	3.41
July	1.34	2.83	2.17	1.47	1.83	2.92	3.06	1.34	1.83	2.58	1.36
August	1.80	2.58	.83	3.43	2.19	1.46	3.67	1.05	2.18	3.52	3.53
September	1.99	2.80	2.02	.61	1.10	3.83	1.37	2.63	.97	1.34	1.4
Total	7.28	9.41	8.59	7.64	7.34	9.77	11.54	6.56	8.12	9.94	9.70
Annual	17.31	19.14	18.62	18.03	14.74	15.55	23.25	15.03	15.91	16.92	20.92
	Yield per Acre (Bushels) †										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Non-irrigated Counties											
Thomas	76	100	44	97	61	88	88	70	70	72	83
Arthur	70	110	50	80	58	80	80	56	76	60	95
Kimball	158	110	74	100	61	77	80	82	67	97	125
Cheyenne	98	116	47	99	55	71	78	56	77	66	100
Lincoln	81	100	53	103	60	90	68	82	74	56	96
Garden	98	122	62	120	95	116	91	80	92	82	110
Average	97	108	55	98	65	87	81	71	78	72	102
Irrigated Counties											
Morrill	188	141	115	140	150	110	115	120	130	140	145
Scotts Bluff	263	172	135	163	164	140	115	137	170	174	175
Average for all counties in western District	129	120	72	113	88	96	88	85	93	83	116
Increase in average yield due primarily to irrigation	32	12	17	15	23	9	7	14	15	11	14

* Data compiled from reports of the United States Weather Bureau and cooperative stations at nine places.

† Data compiled from "Nebraska Agricultural Statistics" issued cooperatively by U. S. Dept. of Agriculture and Nebraska State Board of Agriculture, Lincoln, Nebraska.

fall, especially in August, caused the yield per acre to decrease to 46 bushels.

in the western district (Fig. 5 and Table 2). In 1920 the yield per acre was 98 bushels. The average sum-



FIGURE 6.—After the soil has been carefully prepared, the two-row potato planter is used on a number of the large potato-growing farms in western Nebraska. Sixteen to twenty acres per day can be planted by one man and six horses. Six to seven bushels of seed potatoes are planted per acre. (Courtesy of Kenneth Pruden, Hemingford, Nebraska.)

mer temperature was 65.65° F., while the seasonal rainfall was only 7.64 inches, but much of it occurred during July and August, the important growing months. In 1927 a general cool growing season with a moderate, well-distributed rainfall caused an increase in the yield per acre.

During this same period, the years 1923 and 1926 showed a decrease in the yield per acre even though there was an increase in rainfall. The temperature in July and August, 1923, was relatively high and the moisture was fairly heavy; these conditions were favorable for the development of diseases which undoubtedly reduced the yield. In 1926, the climatic conditions were very similar to those of 1923 and in addition an early freeze caused a decrease in the production.

The importance of moisture in potato growth is shown by the contrast in the yield per acre in the irrigated and non-irrigated counties (Table 2). In Scotts Bluff and Morrill counties, where irrigation is

practiced, the yield averaged from 110 to 263 bushels per acre during the last decade. When these two counties are included, the average production per acre in the western district is increased from 7 to 32 bushels. The maximum differences usually occur in the years when the summer rainfall is lightest.

Since the western potato-producing region lies within the area having a summer temperature of 64° to 70° F. and since the rainfall during the growing season is usually more than 8 inches, potatoes of high quality can be produced upon the uplands although the yield per acre is not as high as in the irrigated areas.

RELATION OF RAINFALL TO THE SIZE OF SEED POTATO PIECES IN THE DRY-LAND REGION OF WESTERN NEBRASKA

As a general rule more stems and a greater yield will result when large seed pieces are planted. The size of the seed pieces is very important in areas having low rainfall because a small seed piece may lose too much

moisture if the soil is dry in the spring. It also has insufficient stored plant food to produce a strong plant with a good root system under droughty conditions. When the seed piece is large, a good-sized plant can be supported by the reserve food until the roots become established and can obtain moisture from the soil. The large seed pieces will also produce higher yields per acre because they increase the set (Fig. 6).

The most desirable seed pieces should weigh between $1\frac{1}{2}$ and 2 ounces. A large crop is obtained by planting 12 to 16 bushels of tubers per acre. The seed should be placed approximately 18 inches apart in the row. This method produces



FIGURE 7.—A two-row, power-driven potato cultivator used in a 120-acre field of dry land certified seed in Kimball County. Power machinery is replacing horse-driven implements and is used on many of the farms. (Courtesy of Glenn Hunt, Kimball, Nebraska.)

diseased and undesirable plants, is easier and more accurate in such fields (Fig. 7).

TABLE 3

AVERAGE TEMPERATURE AND TOTAL RAINFALL, MAY TO AUGUST, AND THE AVERAGE YIELD PER ACRE IN THE CENTRAL CLIMATIC DISTRICT OF NEBRASKA, 1917-1927

Month	Temperature (Fahrenheit) *										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
May	56.6	63.22	57.75	58.3	62.12	61.29	57.99	53.87	58.68	65.48	59.98
June	67.22	73.83	66.48	69.52	74.10	72.6	69.49	67.08	71.8	72.00	67.63
July	76.42	72.94	77.7	74.83	76.81	72.71	74.42	71.29	75.42	76.4	73.91
August	71.02	75.85	72.5	69.21	73.8	76.74	71.6	73.4	73.4	75.37	69.94
Average	67.81	71.46	68.61	68.96	71.71	70.83	68.38	66.41	69.82	72.31	67.84
Average June and July	71.82	73.38	72.09	72.18	75.45	72.65	71.95	69.18	73.61	74.2	70.77
Month	Rainfall (Inches) *										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
May	4.85	4.7	2.8	3.45	5.39	3.43	6.59	1.92	1.79	2.37	2.47
June	2.37	2.2	4.82	3.08	1.61	2.37	5.07	5.29	3.91	1.89	3.38
July	1.18	2.82	3.98	3.23	4.33	4.53	2.42	5.9	2.11	2.70	1.39
August	1.94	2.4	1.51	4.59	2.39	2.46	5.10	5.68	3.69	5.15	3.08
September	3.63	1.02	1.22	1.47	2.11	.9	4.62	2.06	1.44	3.49	2.9
Total	13.97	13.14	14.33	15.82	15.83	13.69	24.84	20.85	12.94	15.60	13.22
Annual	21.69	22.44	25.11	25.76	21.62	20.18	30.87	25.00	20.54	21.42	22.06
County	Yield Per Acre (Bushels) †										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Buffalo	100	91	56	131	75	110	75	130	95	93	124
Custer	90	56	37	97	43	76	68	100	64	35	102
Dawson	82	56	55	105	68	110	73	116	92	70	106
Greeley	79	68	41	97	47	90	63	90	76	34	93
Hall	83	45	48	105	65	75	61	107	58	37	106
Valley	100	79	40	100	57	93	54	105	58	36	105
Merrick	95	38	45	97	54	97	72	113	53	41	80
Nance	87	50	48	91	51	106	73	120	72	55	80
Boone	85	67	50	93	52	104	70	97	77	49	94
Howard	99	60	47	99	50	82	70	107	60	35	90
Average	90.0	64.0	46.7	101.5	56.2	94.3	67.9	108.5	70.5	48.5	98

* Source of data: Reports of the U. S. Weather Bureau and cooperative stations at nineteen places.

† Data compiled from "Nebraska Agricultural Statistics" issued cooperatively by United States Department of Agriculture and Nebraska State Board of Agriculture, Lincoln, Nebraska.

more stems from large pieces and inspection for disease can be made more effectively than if the plants are crowded. Rouging, removing

CENTRAL REGION

As stated previously the central region is the principal source of early

table stock for eastern Nebraska. The growing season for potatoes in this area is from May to August; hence the May temperature and rainfall data are included in this study (Fig. 8 and Table 3).

Despite the early planting of the crop, the temperature variations are among the principal climatic factors affecting the yield. The high yields per acre during the period, 1917–1927, occurred in 1917, 1920, 1922, 1924, and 1927, when the average temperature from May to August was 69° F. or less and the June and July temperature average was lower than 72° F., except in 1922. In that year the mean seasonal temperature increased to 70.83° F. because the August temperature was 76.74° F., but the June and July averages were not high, hence the crop was nearly ripe before the advent of high August temperature. The highest yield per acre, 108.5 bushels, occurred in 1924 when the thermal optimum for potato growth was reached, the average temperature from June to August being 66.41° F. while the June and July average was 69.18° F. These were the lowest mean summer temperatures during the entire period.

The years having the low yields per acre show a mean summer temperature of 69° F. or more while the average temperature for June and July was greater than 73° F., 1919 and 1923 excluded. The lowest production during the decade occurred in 1919 even though the June-August temperature average was 68.61° and the June and July average was 72.09° F. The cool May and June together with moderate rainfall caused a good growth of foliage but the July temperature of 77.7° F., the highest from 1917–1927, and the relatively heavy precipitation were

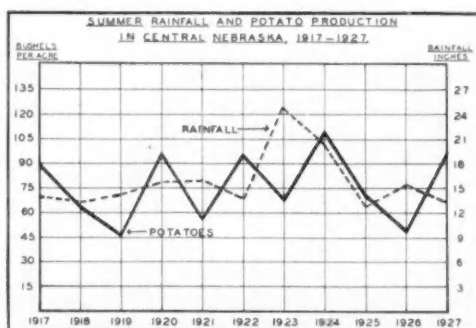


FIGURE 8.—The fluctuations in the yield per acre in the central district are not as closely related to summer rainfall as are those in the western region. High seasonal temperatures are more important in the variations in the yield in the central area than in the western part of the state. (Based upon U. S. Weather Bureau reports, and statistics by Nebraska State Board of Agriculture, Lincoln.)

conductive to the growth of plant diseases which reduced the yield. In addition the low rainfall of August was not sufficient for good tuber growth. The thermal conditions in 1923 were favorable for a higher yield than occurred. However, the low May temperature (57.99° F.) and the abundant moisture of that month (6.59 inches) caused some of the seed to decay and thereby reduced the stand. This was followed by an unusually heavy rainfall and a very warm July which were favorable conditions for losses by plant diseases and insects.

The effects of both high temperatures and unevenly distributed rainfall are represented in the yield of 1926. The production was 48.5 bushels per acre, or the second lowest from 1917–1927. The low June and July rainfall, together with a high July temperature, retarded plant growth while the high August precipitation of 5.15 inches was too late for the development of a heavy yield.

The summer moisture throughout the eleven-year period was ample for good potato crops as the mean

seasonal rainfall varied from 13 inches to 24 inches. The above studies indicate that temperature is a more important climatic factor than rainfall in potato production in central Nebraska.

In conclusion the western potato-growing region lies in an area having a mean seasonal temperature of 64° to 70° F. with practically no hot days or high temperatures in July or August, while the central region is in

SOIL CONDITIONS

The soils of western Nebraska are particularly well adapted to the production of potatoes because they have a relatively high percentage of sand, important in the development of the size and the shape of the tuber. The best soils are the sandy loams of the table lands and those in the valleys of western Nebraska. These usually contain sufficient plant food



FIGURE 9.—A potato picking scene in the North Platte valley of Nebraska. Potatoes are removed from the ground by a digging machine after which members of the family or hired help place the tubers in sacks. The yields in this region vary from one hundred to three hundred or more bushels per acre. Four horses are required for most of the potato diggers. (Courtesy of Lyman Andrews, Great Western Sugar Co., Scotts Bluff, Nebraska.)

a less favorable thermal district because the average seasonal temperature is usually from 67° to 72° F. and the June or July temperatures frequently exceed 72° F. The seasonal rainfall in the central region, however, is greater and more certain than that of the western region; hence, the former has the better moisture conditions while the latter has the more favorable temperatures for successful potato production (Fig. 9).

for the growth of potatoes. They are slightly sandy and generally have porous subsoils which give good underground drainage. In central and eastern Nebraska the soils are of finer texture and heavier and are not so well adapted to potato growth as are the soils in the western part of the state. However, large areas of sandy soils suitable for potato production are available along the Platte, Missouri, Republican, and Elkhorn rivers (Fig. 10).

Comparing the average annual yield per acre in typical counties in each of the three major soil regions in Nebraska; namely, the high plains, the sand hills, and the loess region, the highest average yield per acre was in the high plains (Table 4).

During the period 1917-1927 the annual yield per acre in this region was 86 bushels, and if the counties—Scotts Bluff, Sioux, and Morrill—in the irrigated section are included,

The production per acre in the sandhills may be higher one year than that in the loess region, and during the next year reverse conditions exist, as, for instance, in 1918 the average yield per acre in the sandhills was 110 bushels, while that of the loess region was only 59 bushels. Favorable climatic conditions in the loess region will result in average yields of more than 90 bushels per acre as was the case in 1920, 1924, and 1927.



FIGURE 10.—Digging, picking, sorting, and sacking potatoes in the North Platte valley north of Morrill, Nebraska. A gasoline engine is used to dig the potatoes; thus, the use of only two horses is necessary instead of four as is shown in Figure 9. The potatoes are picked by hand and placed in wire baskets or pails and are then put in the sorting machine which sorts and sacks the tubers. A new machine which automatically digs, picks, sorts, and sacks potatoes was used in Nebraska fields in 1928. This field produced 300 bushels per acre. (Courtesy of Conservation and Survey Dept., University of Nebraska.)

the average yield was 105 bushels. The yield in these irrigated counties was 145 bushels per acre. The sandhills show an average annual production of 77 bushels per acre during the same period as compared with 73 bushels per acre in the loess region.

However, these statistics do not show the actual bearing capacity of the soils of these three regions because climatic variations also influenced the yield (Table 4).

The soils of the high plains region are better adapted to potato growth because they are not as extremely sandy as those of the sand hills, nor are they of as fine texture as the loessial soils. This results in a medium-textured, friable soil, particularly suitable for the growth of well-formed, good-sized potatoes.

If the rainfall in the high plains was as heavy as that in central and eastern Nebraska, these soils would

TABLE 4

AVERAGE ANNUAL YIELD OF POTATOES* (BUSHELS) PER ACRE IN THE THREE SOIL REGIONS OF NEBRASKA, 1917-1927 †

	HIGH PLAINS										
	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
<i>Non-irrigated Counties</i>											
Box Butte	85	111	48	91	80	50	80	46	95	90	107
Dawes	96	119	51	94	86	76	79	56	106	89	109
Sheridan	125	120	40	91	86	81	73	47	105	92	106
Kimball	158	110	74	100	61	77	80	82	67	97	125
Cheyenne	98	116	47	99	55	71	78	56	77	66	115
Average (Yearly)	112	115	52	95	74	71	78	57	90	87	112
<i>Irrigated Counties</i>											
Sioux	118	103	120	147	145	112	110	105	140	153	149
Scotts Bluff	263	172	135	163	164	140	115	137	174	174	175
Morrill	188	141	115	140	150	110	115	120	130	140	145
Average (Yearly)	190	139	120	147	153	121	143	121	146	156	156
Average Yield in High Plains	141	124	66	114	97	87	91	81	112	113	129
SAND HILLS REGION											
Grant	50	110	43	80	60	83	81	50	75	61	93
Hooker	91	117	45	75	63	90	73	60	75	70	85
Arthur	70	112	50	80	58	80	80	56	76	60	95
McPherson	85	105	46	92	61	75	65	58	80	68	98
Cherry	90	117	48	91	80	50	80	46	95	75	92
Thomas	76	100	44	97	61	88	88	70	70	72	83
Average (Yearly)	77	110	46	86	64	78	78	60	79	81	91
LOESS REGION											
Dakota	106	80	65	131	66	131	83	130	53	84	110
Boone	85	67	50	93	52	104	70	97	77	49	94
Adams	89	41	47	105	58	60	61	91	49	33	90
Lancaster	77	31	81	42	54	63	70	90	33	49	70
Thayer	59	29	37	103	49	50	71	84	44	41	80
Richardson	76	63	45	61	46	54	90	125	44	65	73
Buffalo	100	91	56	131	75	110	75	130	95	93	124
Hall	83	45	48	105	65	75	61	107	58	37	106
Average (Yearly)	84	59	53	96	58	81	73	93	57	56	93

* The importance of rainfall in the yield of potatoes per acre is indicated in the high yields per acre in the high plains and in the sand hills region in contrast to the yields in the loess region in 1918. During that year the rainfall was heavy in the western region while it was unusually low in eastern Nebraska.

† Data compiled from "Nebraska Agricultural Statistics" issued coöperatively by United States Department of Agriculture and Nebraska State Board of Agriculture at Lincoln, Nebraska.

‡ The following data may be of interest: average, 1917-1927, non-irrigated counties in High Plains, 86 bushels; average, 1917-1927, irrigated counties in High Plains, 145 bushels; average, 1917-1927, in High Plains, 105 bushels. The average, 1917-1927, in Sand Hills Region was 77 bushels, while that in the Loess Region was 73 bushels.

produce higher yields than they do at present and would be likely to exceed those of the loessial soils.

NEBRASKA CERTIFIED SEED POTATOES

Nebraska has developed a high position as a source of certified seed potatoes for the southern states and the Bermuda Islands. The quality of the seed tubers produced in the dry land areas of the high plains is very high, and the demand for Nebraska seed is now greater than the supply. The seed potatoes mature rapidly in the southern states and produce plants usually quite free from disease. Experiments conducted in Louisiana, Texas, and Arkansas show that Nebraska

seed potatoes are superior to those of most of the northern states in that they show less disease than others, and produce a higher yield per acre.

During a four-year period, the results of experiments of using Nebraska certified seed at the Louisiana Experiment Station averaged in primes 144.6 bushels per acre, with only 7.9 per cent mosaic disease. Fifteen lots of Nebraska certified seed were tried. These produced approximately 45.3 per cent more than the seventeen lots of uncertified seed which were used as checks. The amount of mosaic in the checks was 47.5 per cent. During the same four-year period sixteen lots of Wisconsin certified seed averaged

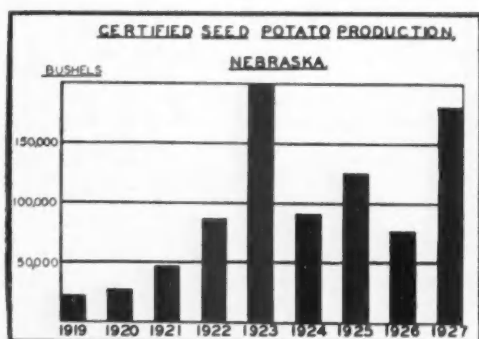


FIGURE 11.—Certified Seed Potato Production has increased from 20,000 bushels in 1919 to 181,500 bushels in 1927. The heavy crop in 1923 caused a surplus of potatoes which resulted in low prices, hence the low production in 1924. The value of using certified seed potatoes in the southern potato-growing regions during the last few years has now increased the demand for northern-grown seed potatoes. The production in 1926 was lower because an unusually early freeze in western Nebraska caused a heavy loss in the yield. (Based upon statistics by Nebraska State Board of Agriculture, Lincoln.)

139.8 bushels of prime potatoes per acre, which was an increase of 40 bushels per acre average over the checks of uncertified seed. The average per cent of mosaic was 23.9 in the certified potatoes.¹

The Nebraska certified potatoes are raised from carefully selected seed, treated for disease before planting. The crop is rouged two or three times during the season in order to remove plants which are diseased or not suited for seed. The tubers thus produced are relatively free from disease because they are carefully grown on the uplands in a relatively cool, dry climate.

Diseases such as the mosaic and spindle tuber are carried by insects, especially the sucking type, as the plant lice, which live in moist and warm climate. Other diseases are more easily carried by water in the ground. As a result, the potatoes

¹ Professor G. L. Tiebout, Department of Horticulture, University of Louisiana, Baton Rouge, La., Fifth Annual Report, Nebraska Potato Improvement Association, 1923.

produced in the higher, dry land areas are of higher quality and are in greater demand for seed than are those grown in the irrigated districts and in the warmer, more humid sections of the eastern and central parts of the state.

The Nebraska seed production has increased from 20,000 bushels in 1919 to 181,500 bushels in 1927 (Fig. 11). The annual yield during that period averaged 94,000 bushels.

The principal markets for Nebraska seed are in Texas, Louisiana, Oklahoma, Georgia, Mississippi, Alabama, Florida, and Tennessee, Texas being the most important consumer and Louisiana second. Some seed has also been sold to the Bermuda Islands (Fig. 12). From 3,500 to 4,400 carloads are shipped annually from the principal shipping points in Nebraska. Approximately 78 to 85 per cent of the carlot shipments originate in the six leading potato-producing counties in the western part of the state.

The price received for Nebraska certified seed potatoes is usually one dollar or more per hundred weight than for table or uncertified seed. In 1927 the farmers received two dollars more per hundred pounds than for common potatoes and the price was one dollar greater per hundred weight than for the certified seed from other states.

Approximately two hundred carloads of certified seed potatoes were shipped from Nebraska in 1927 and reports indicate that about four hundred carloads were marketed during 1928 (Fig. 13).

As a response to the demand by the southern growers for seed for early planting a method has been developed which causes potatoes to sprout and grow more rapidly. It

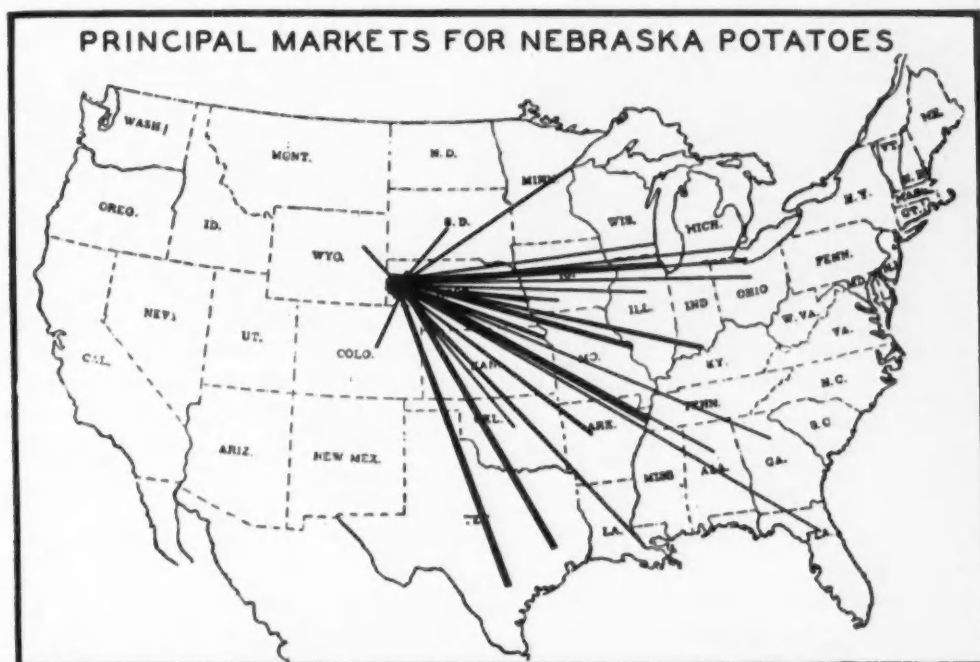


FIGURE 12.—Principal markets for Nebraska potatoes, both Certified Seed and table stock. Some of the principal cities receiving potatoes from Nebraska are Chicago, Memphis, Omaha, St. Louis, Kansas City, Houston, and Dallas. (Based upon U. S. Bureau of Agr. Economics reports, and statistics by Nebraska State Board of Agriculture, Lincoln.)

is generally known that potatoes were treated with ethylene chlorohydrin after which they were shipped directly to Florida and to the Ber-



FIGURE 13.—A scene showing sacked potatoes ready to be hauled to the storage cellar or market. Mexicans and Indians are among the potato pickers employed in western Nebraska. The sorter and sacker, which is moved about by a horse, makes the filling of sacks easier and quicker. Potato pickers usually pick from 95 to 110 bushels per day. Some Indians pick as high as 135 to 145 bushels per day. (Courtesy of Lyman H. Andrews, Great Western Sugar Co., Scotts Bluff, Nebraska.)

start to grow. In early October, muda Islands and there planted 1927, twenty to twenty-five carloads of Nebraska certified potatoes immediately. Certified potatoes which had not been treated were

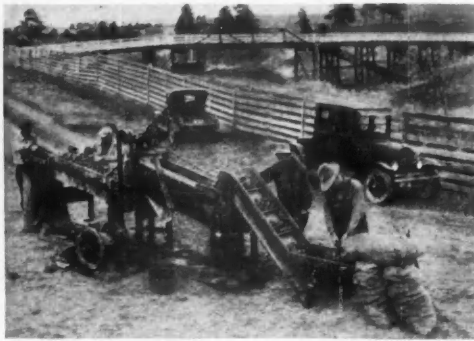


FIGURE 14.—A sorting machine which sorts and sacks potatoes in preparation for the market. In many fields the sorting is done at the same time as the potatoes are picked. (Courtesy of Conservation and Survey Dept., University of Nebraska.)

planted at the same time. The results were that plants from the treated tubers were appearing above the ground by the latter part of October while the others did not come through the soil until six weeks or two months later. The treatment is a real factor in potato production

times in the southern states, and with this treatment, it will no longer be necessary for the seed to be stored for a length of time before it will sprout and grow (Fig. 14).²

PRODUCTION AND VALUE

The average annual acreage of potatoes from 1919–1927 was approximately 96,000 and the production was 7,903,000 bushels. The annual value of potatoes per acre during the last nine years was \$89.02 and held second place among all crops in Nebraska while sugar beets ranked first at \$95.69 per acre. These were followed by tame hay at \$24.89, wheat at \$18.11, and corn at \$16.92 per acre (Fig. 15). Thus, although the acreage of potatoes is not large compared with the total acreage of wheat, corn, and tame hay, the value per acre is greater.

Potatoes are important as an ele-

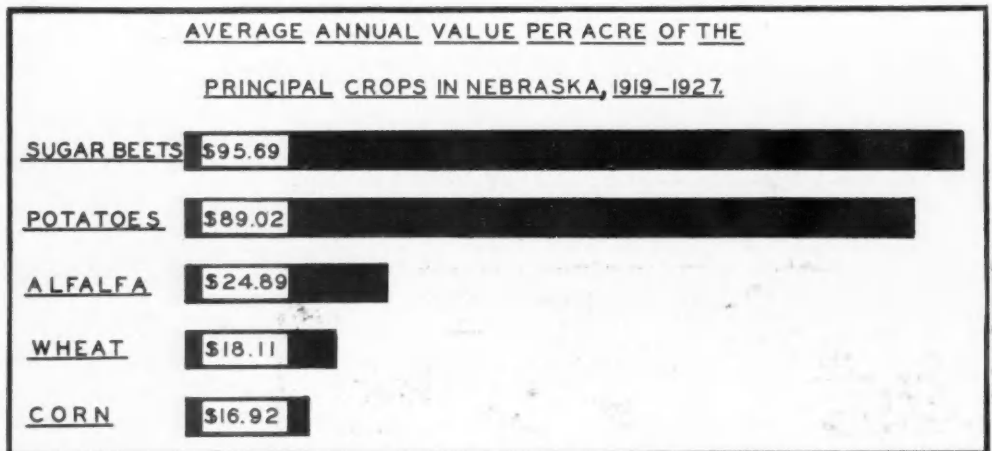


FIGURE 15.—The value of potatoes per acre was second of all crops in Nebraska, being surpassed only by sugar beets. (Based upon statistics by Nebraska State Board of Agriculture, Lincoln.)

in the south where growers must have seed to plant in the early winter. With this method of crop raising, new potatoes may be available on the market continuously because they can be grown at all

ment in crop rotation. Increased yields of crops following potatoes continue several years because care-

² Report of Mr. H. O. Werner, Department of Horticulture, University of Nebraska, Lincoln, Nebraska.



FIGURE 16.—Hauling sacked potatoes from the storage cellar to the car or market. Note the entrance to the potato cellar. Horses are the principal sources of power for hauling potatoes. However, trucks are used extensively for haulage in some of the areas. (Courtesy of Kenneth Pruden, Hemingford, Nebraska.)

ful tillage results in a good condition of the soil and the fertility is increased by the addition of considerable organic matter from decayed roots and plants. In some instances when prices are low and the potato crop is financially a failure, the added fertility which increases the yield of grain crops counteracts the loss.

The rotation of crops also decreases the percentage of disease in potatoes.

and were fairly free from scab while continuous potato cropping showed a low yield of scabby tubers.³

SHIPPING CENTERS

The average annual shipments of commercial potatoes in Nebraska from 1919–1927 were approximately 2,400,000 bushels of nearly 3,500 carloads.⁴ From 78 to 85 per cent of the carlot shipments originate in

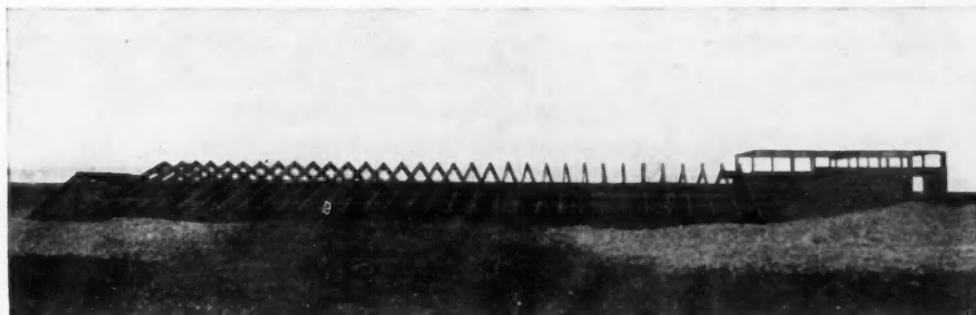


FIGURE 17.—The construction of a large potato storage cellar in western Nebraska. The capacity of these cellars varies from two thousand to approximately seventeen thousand bushels. The wire lying across the rafters is covered with straw or grass and dirt to make the cellar warm. A door is placed at each end. The one to the left is sealed with straw and dirt after the potatoes have been stored. The one to the right is in a covered house which is made of tile or close construction in order to shut out the low temperatures of winter. Some cellars have only one door which makes it necessary to back the wagon in one direction. (Courtesy of Conservation and Survey Dept., University of Nebraska.)

The yield of potatoes grown in different rotations at the Scotts Bluff Experiment Station show that potatoes grown in the following rotation—oats; (manure); beets; alfalfa; alfalfa; alfalfa; potatoes—had the highest yield per acre (363 bushels)

the six leading potato-producing counties of western Nebraska (Fig.

³ Report, Nebraska Potato Improvement Association, 1920, page 13.

⁴ Nebraska Agricultural Statistics, 1926, issued coöperatively by the United States Department of Agriculture and Nebraska Department of Agriculture at Lincoln, Nebraska.



FIGURE 18.—Interior of a very good farm potato cellar. Each bin holds four hundred or more bushels. The double walls between the bins and ventilators make good ventilation. This type of cellar is very common in the potato districts of western Nebraska. (Courtesy of Nebraska Farmer, Lincoln, Nebraska.)

16). In Sheridan and Dawes counties, the principal shipping points are Gordon, Hay Springs, Rushville, Marsland, from which approximately 600 to 700 carloads are shipped annually. An annual output of 850 to 900 carloads of potatoes were marketed from Hemingford and Alliance in Box Butte County. The principal loading centers in the irrigated region are Morrill, Mitchell, Henry, and Scotts Bluff from which 1,500 or more carloads of table stock are shipped annually (Fig. 17).

From 150 to 200 carloads are marketed from the north central district in Brown County, the chief shipping points being near Ainsworth.

Approximately 700 to 800 carloads of early potatoes are marketed from Kearney, Gibbon, and Buda in the central region. Shipments start about the middle of July and average from 15 to 20 carloads per day from July 15 to September. Eastern Nebraska and Chicago are the leading markets.

Some of the principal cities receiving Nebraska potatoes in 1927 were Chicago, 350 carloads; Memphis, 334 cars; Omaha, 348 cars; St.

Louis, 246 cars; Kansas City 159, and Houston, 93 cars.⁵

Summarizing, the western and central districts are the most important producing and shipping regions of both seed and table stock, while eastern Nebraska, the middle, and southern states are the important consuming centers (Fig. 18).

CONCLUSION

The best potato crops in Nebraska are produced in the western part where the mean summer temperature is 66° to 68° F. and the July or August temperatures do not exceed 72° F. When the seasonal temperature is greater than 68° F., or the mid-season average is high, the production per acre is usually from 20 to 35 bushels less than in cooler seasons. Although the temperatures during the day are often high in this section of the state, the nights are cool, which factor causes less transpiration and aids the plants in storing the food. In contrast, the climate in eastern Nebraska is more humid, the temperatures during the day are quite high, and the nights are usually warm—conditions ideal for corn production; hence corn is better adapted to the climate in the eastern part while potatoes are more suited to that in the western part. The summer rainfall is generally ample in all areas for potato culture, but it is usually insufficient in the western region for corn production.

Inasmuch as the climate and soil conditions of western Nebraska are most favorable for potato growth, the major part of the commercial crop will continue to be produced in that part of the state.

⁵ U. S. Department of Agriculture, Bureau of Agricultural Economics, 1928, Washington, D. C., and "Nebraska Agricultural Statistics."

The demand for Nebraska Certified Seed potatoes in the southern states and in the local markets makes the outlook for the expansion of the industry very promising. These, together with the favorable physical conditions for potato growth, will not only result in larger crops, but also in the production of higher-quality potatoes.

AGRICULTURE IN THE DRY REGION OF THE U. S. S. R.¹

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THE various regions of the vast Union of Soviet Republics differ greatly in their physical character and their types of farming. Among these the Dry Region that borders the Black Sea on the north, includes the lower and central Volga Valley, and extends eastward to the Altai Mountains in Central Asia, offers some of the most difficult problems in adjusting agriculture to the physical conditions.

BOUNDARIES OF THE DRY REGION

From the agricultural standpoint, the name "dry region" is applied to those areas of deficient rainfall and high summer temperatures where ordinary agricultural methods frequently fail to produce a crop. There are, of course, no definite natural boundaries to dry regions, for types of farming, as well as types of climate, gradually change. In the southern U. S. S. R., agriculture, in general, becomes unstable where the average annual precipitation is below 400 millimeters (16 inches); consequently, for the purposes of this paper, the isohyetal line of 400 millimeters is made the northern boundary of the Dry Region.² Yet even this isohyet is not everywhere accepted as the boundary, since in the Asiatic part of the U. S. S. R. the

southern limit of chernozem (black-earth) soils is made the boundary, conditionally, and the eastern boundary is not extended beyond the Altai Mountains. Sufficient knowledge of the exact boundaries in these areas is not yet available.

If we accept these boundaries on the north, the extent of this Dry Region would be approximately as follows: the European part begins with the narrow strip at the western borders of the U. S. S. R. along the shores of the Black Sea; this strip gradually widens to the northeast, where it includes the southern portion of the chernozem zone, or what the soil experts designate "Southern Chernozem." To the south it embraces the chestnut brown to light gray, semi-arid soils, which were formed under conditions of considerably less precipitation and more insolation than the true black-earth soils to the north.

The isohyet of 400 millimeters of annual precipitation, which is adopted conditionally as the northern border of the Dry Region, passes a little south of Kharkov, Voronej, Tambov, and Penza. The line then follows north of Ulianovsk and Samara, circles around the foothills of the Ural Mountains near Ufa, and then goes east into Siberia. As has been previously stated, the northern boundary of the Dry Region in Siberia follows the southern limit of chernozem soils. This boundary passes a little north of Petropa and Omsk to the foothills of the Altai Mountains. South of this boundary

¹ Translated by J. W. Pincus.

² In the Great Plains Region of North America the isohyets trend from the north to the south, where the evaporation is much greater and the rainfall more torrential, hence no single isohyet can be used to bound the dry regions in the United States. In the U. S. S. R., on the other hand, the isohyets trend east and west in the same general direction as the isotherms.

nearly the entire area in the U. S. S. R. has the characteristics of the Dry Region, *i.e.*, climatic conditions, and locally soil conditions, also, unfavorable to crop production in greater or lesser degree.

In the foothills and tablelands of the Tian-shan, in the foothills of the Pamir-Altai, in the Hindu Kush, and in part of the Kopat-Daga, which form the political boundary of

Within these boundaries the total area of the Dry Region may be roughly estimated at 5,400,000 square kilometers (2,100,000 square miles). This is about one-fourth of the total land area of the U. S. S. R.

THE CENTRAL AND LOWER VOLGA AREAS

The wide variation in physical conditions within this vast region,

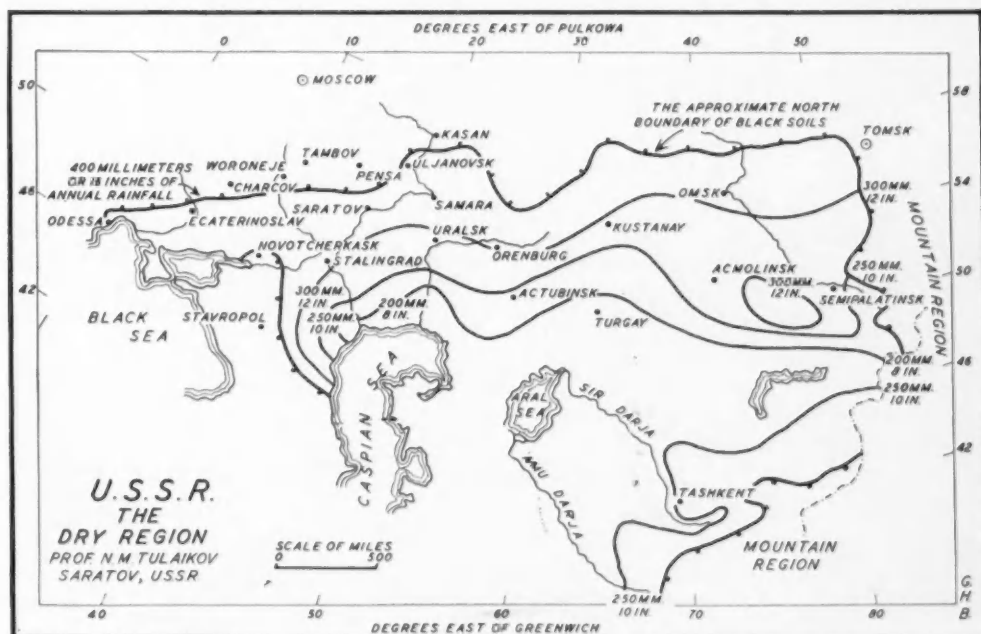


FIGURE 1.—The relation of the rainfall to the soils, natural vegetation, and agriculture of much of the richest crop-producing area, particularly in the dry-farming regions of Russia is peculiarly significant. On this map the isohyets within the Black Soil Belt reveal this significant and intimate relation.

the U. S. S. R. along the east and south, is situated a strip of land having 250 millimeters or slightly more precipitation per year. Accepting, provisionally, that it is impossible to grow crops without irrigation where the annual precipitation is less than 250 millimeters, and also accepting provisionally that in most of these foothills the annual precipitation is 250 to 400 millimeters, these lands appear suitable for dry farming, where the lay of the land permits.

as well as the almost complete lack of knowledge of large parts of the Asiatic portion, particularly of Kazacstan, formerly known as Kirghisia, make it difficult to describe accurately or adequately all this territory and the various agricultural methods employed. It is safe to state, however, that in districts where the annual precipitation is less than 250 millimeters there can be no crop production without artificial irrigation. Such districts can be utilized

only for pasturing livestock, perhaps only for nomad grazing, and for this reason they will not be considered in this discussion.

In the remainder of the Dry Region, where the annual precipitation varies from 250 to 400 millimeters, farming can and must be organized along definite lines that are distinct from ordinary agricultural practice in

positive and negative features. The history of colonization and agriculture, moreover, is almost a history of development throughout the Dry Region, not due to accident but to the influence of geographic conditions. However, the Volga area is farther advanced in development. Local inconsistencies between the physical habitat and the types of



FIGURE 2.—Only along the rivers of the steppes is there any arborescent vegetation. For miles between the streams not a trace of tree or shrub of any size is evident.

humid regions. As sufficient data are not obtainable from the scientific experimental institutions in the Asiatic part of the Soviet Union, this discussion will be confined to the systems of dry farming in the central and lower Volga areas, which have been more thoroughly investigated, than other parts of the region.

This part of the Dry Region is typical in its nature and its methods of farming, and therefore may well represent the whole Dry Region. Its agriculture has both definite,

farming occur in this type area, and similar discrepancies may reasonably be expected to develop in the Asiatic and other portions of the Dry Region. Sufficient material is obtainable from the local experiment stations in the Volga area which have been in operation for a number of years, to provide a diagnosis of the ills of the local agriculture and to evaluate the farming in the future. The agriculture of the Asiatic part of the Dry Region is likely to pass through the same stages that the Volga area has passed



FIGURE 3.—The steppes of the Northern Caucasus reveal the same monotony of landscape as elsewhere in Russia, miles and miles of open grassland country.

through, and correct systems of farm organization in the Volga area should serve as an example to the farmers in those Asiatic sections of the Dry Region which have not yet been investigated.

PRINCIPAL CHARACTERISTICS OF THE VOLGA AREA AND ADJACENT LANDS

The southwestern part of former European Russia, which embraces the central and lower Volga area, beginning with Samara Province and including a portion of the present Northern Caucasus and all the southern Ukraine, has distinct physical characteristics which influence specifically the methods of agriculture employed. Moreover, these methods are very similar throughout.

Soils

The soils in these areas vary from the fertile chernozem (black soil) to the infertile shifting sand which blows along the steppes and covers, at times, the better soils of the region. Between these two extremes there are many grades and varieties of soils. It is unnecessary to discuss in detail

the characteristics of these soils. Although they differ greatly, they have one common and distinctive characteristic—their youth. They are all grassland or desert soils, not leached as are most soils in humid regions; and as all have been cultivated only recently, they are still naturally rich in plant food and require scarcely any fertilization.

Under natural conditions in the Dry Region, the yield of the crops is determined not by presence of the plant food elements in the soil, as is the case in the central and northern parts of the Soviet Union, but by the quantity of the rainfall and of moisture in the soil. With a low moisture content, the yield of crops under ordinary methods of cultivation by peasants cannot be very high, and partly for this reason the fertility of the soil cannot quickly be exhausted. If the yields should increase notably the problem of maintaining soil fertility, particularly in some of the soils, might, after a few decades, become pressing. However, at the present time, the question of the fertility of soil in the Dry Region



FIGURE 4.—Great areas of the drier steppes have not been broken by the plow for years. These are occupied solely by nomadic herds and flocks grazing the rich grasses, watering at the widely scattered waterholes or the widely separated streams.

cannot become an important problem.

Notwithstanding the variety of the soils in these dry regions, they are nearly all suitable for agriculture, except the sandy soils that blow or drift badly after plowing. In addition to the general richness in plant food, most of the soils are easy to

there are also some soils unfit for agriculture, the so-called "solonzi" (solonetz), or alkali meadows, which abound throughout the lower Volga regions, particularly on the left shore. Though occasionally this type of soil occurs in the holdings of peasants, it is usually not cultivated, as there are still sufficient better lands available.



FIGURE 5.—In Kazakstan, extensive stretches of alkali steppes, more or less sparsely clothed with salt desert type of vegetation, some of it palatable and nutritious grazing, constitute a conspicuous part of the landscape.

till. Only the soils on the left shore of the lower Volga in the former counties Novouzensk and Nikolaevsk, of the Province of Stalingrad, are heavy and require much breaking, particularly after they have been fallowed or kept in sod. Locally

Climate

Since in practically all portions of the Dry Region the temperature is sufficiently high for crop production, the moisture conditions exert the dominant influence. In studying these moisture conditions, not only



FIGURE 6.—A stretch of alkali desert in the more arid regions, with desiccated pools and flats encrusted with mineral salts, interspersed among the patches of low salt bush vegetation.

the quantity and the areal distribution of the rain or snow, but also the manner of occurrence and seasonal distribution during the year must be considered.

In the Dry Region of the Soviet Union the annual precipitation is considerably less than in other agricultural portions of the U. S. S. R. In other regions producing grain, where the crops do not frequently suffer from drought, the annual precipitation is from 400 to 600 milli-

ducted during many years by the agricultural experiment stations in this region prove that the main difficulty is not the small total annual precipitation, for if it could be properly utilized, and if it came at the proper time, it would be sufficient for securing fairly good crop yields. But, the rains fall irregularly and there are often long intervals between rains. Occasionally, in exceptionally dry years, there is no rainfall during the periods when



FIGURE 7.—Another view of the broad stretches of barren alkali lands, bare and glaring under the summer sun, desolate and dangerous under the gray skies and biting winds of winter, but affording considerable pasturage in the interspersed patches of desert shrub and grass.

meters (16 to 24 inches) annually. In many of the districts of the Dry Region, and particularly of the Volga area, agriculture is practiced where the annual precipitation is only from 250 to 300 millimeters (10 to 12 inches), or one-half to one-third that of the northwestern agricultural regions. However, investigations con-

it is most necessary for the development of the crops.

This irregular and capricious distribution of rainfall during the year is characteristic of the Dry Region. Early spring rains shortly after seeding of spring grains are essential for the farmer, but it may happen, as, for example, in 1921 and 1924, that

from the beginning of the spring until the harvesting of the spring wheat, there was very little rain, and the plants had to subsist on the supply of moisture in the soil stored during the fall and winter months. Only in cases where the soil had been tilled properly was there a sufficient supply of moisture to produce even a meagre crop.

In addition to the lack of precipitation, particularly during the growing season, hot, dry summers have serious effects. This peculiarity of the climate, however, has some advantages, for hay and grain dry rapidly, and almost without difficulty. Nevertheless, the heat and the dryness of the air force both the cultivated and wild plants to evaporate the soil moisture very rapidly, leaving so little in the soil that the plants wilt and sometimes die.

Finally, the so-called "zapali," "zachvati," and "mgli" (sandstorms, dust mists, etc.), which are almost unknown to the peasants in the central part of Russia, frequently occur in the Dry Region and diminish greatly the yield of spring grains, sometimes destroying the crop.

On the other hand, the peculiar climate of these regions bestows some benefits. The products are usually of higher quality, that of wheat being richer in protein, one of the most valuable constituents. Melons yield luscious fruit. Forage crops abound in rich nutrients on which it is easy to fatten meat-producing animals. If all these favorable peculiarities of climate could be utilized, and if the farmer could adapt himself to the unfavorable conditions, farming could then be made very profitable, as is proved by the agricultural experiment stations.

Approximately one-fourth of the



FIGURE 8.—Birch woods in Kazakstan where a bit of better-watered terrane and diminished evaporation permit the establishment and growth of an arborescent cover, particularly toward the northern border.

yearly precipitation in the Volga Region falls in winter in the form of snow, but frequently the snow does not cover the soil as the constant winds blow it off from the fields into the ditches or woods. Because of the general lack of moisture for the growth of farm crops, methods of holding the snow in the fields (by leaving stubble, etc.), so that it can be utilized afterward by the cultivated plants are very helpful. But in some parts of the region it is claimed that the increased crop yields that result scarcely repay the cost of holding the snow in the fields. Nevertheless, under certain conditions it is practicable and even necessary to do so if a permanent agriculture is to be maintained in these regions. Experiments at the Saratov Agricultural Experiment Station show that holding the snow on the fields has, under favorable conditions, created a deep penetration of moisture into the soil, and this in turn exerts a distinct influence on the development and yield of plants, particularly during dry years, tending to equalize the yields

from year to year. The holding of snow appears to be the simplest method of increasing crop yields in this Dry Region, and it is a method available to every peasant.

CHARACTERISTICS OF DROUGHT

What is drought and what are its characteristics from the standpoint of the farmers in the Dry Region? In order to obtain an answer to this question some data of the experiment stations in the Volga area must be studied.

precipitation in March is low, increases in April and still more in May, and reaches the maximum during the summer months of June, July, and August. In the fall, during September and October, the precipitation diminishes, and the minimum occurs during the winter months of December, January, and February. For example, the following table shows the average monthly precipitation for many years at the Experiment Station near Bezenchuksk in the Province of Samara.



FIGURE 9.—A flat sandy valley where the short bunch grass vegetation characteristic of the drier portions of the American high plains affords nutritious, though scanty, pasturage for the wandering herds and flocks.

Meteorological

The years of crop failure usually are years of low precipitation. However, not all years with low precipitation result in crop failures, as can be proved by numerous examples within the memory of the peasants in the region. For example, the year 1909 had the lowest precipitation in the decade in Samara Province, but the crop yields were almost the highest in the history of the province. The explanation lies in the time when the precipitation occurred.

Normally, according to the averages of many years' records, the

Month	Millimeters
January	13.6
February	11.6
March	13.6
April	22.8
May	38.1
June	46.5
July	43.2
August	47.8
September	37.1
October	26.9
November	30.8
December	16.1

Notwithstanding that the July precipitation is not of much use to the spring grain crops, particularly wheat (since growth is almost complete by this time), this seasonal distribution of rainfall insures an average, if not a high yield, particularly if the diversification of crops is practiced.

Individual years differ greatly from the average in the quantity and time of precipitation. Often during April, May, and June, the most important period of plant development, the precipitation may be so low that it plays no part in the growth of the plants. The moisture in the soil in these cases gradually, but markedly, diminishes, the temperature of the air and soil rises, and there results exceptionally unfavorable conditions for the proper growth of the plants. From early spring until July 15, 1924, on a very extensive area in the Volga

the soil to replace this water causes the plants to perish long before they mature. The lack of moisture in the air is often the immediate cause of the decrease in plant growth during drought, and this fact must be taken into consideration in devising methods of combating drought.

DROUGHT AND THE CROPS

This unfavorable combination of a dry spring and a hot summer affects some crops more than others. Winter rye and winter wheat develop usually a sufficiently deep root sys-



FIGURE 10.—A shrub-dotted steppe in Saksaul, where more dependable rainfall permits the growth of widely scattered shrubs and a dense covering of nutritious grasses.

sub-region there was practically no rain, and thus the plants had to utilize the supply of moisture which was already in the soil. As this supply was limited, not all plants could persist. The spring grains could not take root, as the soil was exceptionally dry, and the crop was practically a failure.

During the summer precipitation is only one, although a very important, factor in plant growth. On account of the heat and the dryness of the atmosphere during a drought, the plants are forced to evaporate more moisture, in order to lower their temperature and thus equalize, to a certain extent, the difference in the amount of moisture between the air and themselves. The inability of

tem to withstand fairly well the spring drought, although it affects somewhat the yield. But with the spring grain crops, particularly spring wheat, the results are more serious. If the early sown spring wheat germinates well, the drought quickly dries out the upper layers of the soil, and the small wheat plant cannot develop its root system. The secondary roots of the wheat plant are unable to take root in the dry layer of soil, and the plant remains with only its primary root, which cannot supply it with sufficient moisture.

This rooting of wheat is a very critical period, and if roots are not formed at the proper time, the crop cannot be assured. For spring



FIGURE 11.—A growth of *Salsola kali* where the steppes have been irrigated. The fertile soil when thus adequately watered produces heavy yields of crops, but such weeds as this also develop luxuriantly unless great care and labor is expended in restraining them.

wheat, of all crops, the spring drought is most dangerous, as it determines the crop. The effect on the other spring grain crops, oats and barley, is only a little less serious.

The case is quite different for that group of plants that are called cultivated or row crops, such as corn, sorghum, sunflower, proso-millet, and sugar beets. Most of these crops make a very slow and weak growth in the spring, and for this

nounced lack of rain during the spring, they start growth near the end of June or beginning of July, which is usually too late for early spring grain. Thus, starting growth in the early summer, these cultivated plants are able fully to utilize the summer precipitation which is of practically no use to the spring grain. Almost the same can also be said of the other cultivated crops, particularly of the perennial hay and fodder



FIGURE 12.—Saratov District Agricultural Experiment Station, one of its experimental fields in the foreground. This station is the central institution for the study and development of the Dry Regions and their agriculture.

reason the early spring drought does not affect them very much. They develop rapidly in June and July, when the temperature of the air rises considerably, and it is usually about this time that the spring drought is broken. If there has been a pro-

crops. Usually the latter develop rapidly on the moisture which remains in the soil in the spring, and are ready for a cutting by the middle of June. Then, utilizing the rains of June and July, they grow rapidly during the warm season of the year.



FIGURE 13.—Spring wheat planted in wide drills in order to make the best use of the scanty moisture supply in the fertile soil.

At times drought continues until June and even July. In this case again the crops most injured are the spring grains, particularly spring wheat. Under normal weather conditions, the heads of spring wheat fill in the second half of June, but if the weather is very dry and hot, the grain of the wheat becomes shriveled and the yield rapidly diminishes.

It is evident that absence of precipitation in spring and high temperature in early summer are very destructive only to one group of crops—the spring grains. For this reason such drought is most destructive in those regions where these crops, principally, are grown. In all the Dry Region, and particularly in the Volga area, the main crops, until very recently, have been spring wheat and other spring grains. It is partly for this reason that this region has so often suffered from drought. In this region there have now been developed new methods of combating drought. These consist principally in adapting the crops and the method of farming to the climate of the region.

CROP PRACTICES AND DROUGHT

The year 1924 afforded an interesting comparison of the difference in the condition and yield of grain on the fields of the experiment stations and on the neighboring peasant fields. In all cases it was clear that on the fields of the Experiment Station, with exactly similar soil and weather conditions, there was a considerably greater yield of spring and winter grains than on the adjoining peasant fields. In many instances the yield on the fields of the Experiment Station was two or three times that of the peasants' fields. Why should this difference exist?

In the first place, the Experiment Station fields are carefully cultivated, and, as a result, the soil has acquired improved physical characteristics, particularly the ability to hold more moisture, and better aëration. The experimental fields were also freer from weeds, which take much moisture from the soil. These conditions permit the crop plants to feed better. Besides, these fields were plowed at the proper time, harrowed before seeding, and seeded with varieties of wheat and other crops suitable to the local conditions. Quite the contrary is observed on the adjacent peasant fields. Irrational tilling of the soil, untimely and poor plowing, seeding with poor and weedy seed, on fields already badly infested with weeds—this is a fair picture of the ordinary grain farming in the Volga area. In fields which have been poorly plowed and not at proper intervals, there is insufficient moisture to grow a crop.

Of course, it happens occasionally that the spring wheat on the experimental field cannot stand the adverse weather conditions and gives very

low yields, sometimes as low as two to three quintals per hectare (three to four bushels per acre), but in such cases the adjacent peasant field usually produces no crop at all. Even if it cannot be said that the experimental fields always produce good yields of spring wheat, it may be said that a complete failure can be avoided by using proper seed and correct methods of cultivation.

CAUSES OF CROP FAILURE IN THE VOLGA AREA

Within the memory of the present generation the Volga area several

war and revolution diverted the attention of the people from agricultural improvements, but the two successive droughts of 1920 and 1921 in the Volga Region again compelled consideration of the difficulties confronting this region. Only three years had passed when the terrible drought of 1924 again afflicted the greater part of the Volga Region, and again the question was asked, "What are the causes of the drought, and how can these destructive conditions be overcome?"

It is the belief of the people that the droughts are becoming more



FIGURE 14.—"Planet" cultivators in use in the hand-cultivated areas of the steppes where labor is abundant and cheap, and capital and other power scarce.

times has suffered terribly from complete crop failures. Many remember the year 1891 when the crop failure embraced a very large area of former southeastern European Russia, and the government had to take special measures of relief to save the population from starvation. The droughts in the years 1901 and 1906 were less extensive, but the crop failure of 1911 recalled the horrors of 1891. As this crop failure occurred, however, after two years of good crops, the population withstood it fairly well. Nevertheless, government and private relief were again necessary, and special attention was paid to the local methods of agriculture.

After a series of favorable seasons,

frequent and severe. But there are no reasons to suppose that the climate has changed during the last decade, or even during the past century. Undoubtedly, droughts occurred in the past, but evidently they were not remembered by the population, perhaps because the fewer people depended more on pastoral products in early years, and they were recorded in the official history of the region only when the damages to agriculture were very extensive and noticeable.

In the history of the agriculture in a given locality, particularly in a dry region, there can be noticed at a certain density of population what appear to be harmonious relations

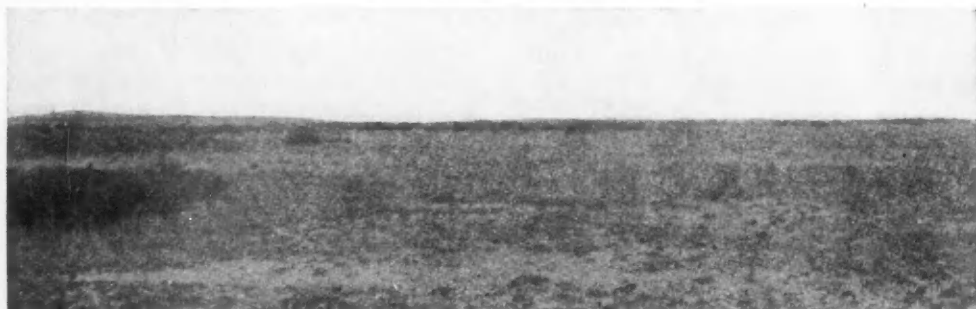


FIGURE 15.—“Komplexnia” steppe, one of the widely distributed types in contrast with “Kompekovskaia” steppe.

between the natural conditions of the region and the type of agriculture. In these cases agricultural practices in a given territory harmonize so closely with the natural conditions and with the agricultural economics of the whole country, that occasional sharp changes of natural conditions from normal do not disturb greatly the economic balance, nor the life of the people. This is particularly true of the primitive methods of agricul-

Stalingrad, Astrakhan, Ural, and the present German Volga Republic, the census of 1926 showed 7,300,000 hectares of crops as follows:

Crop	Hectares	Per Cent of Total Area (Approximately)
Winter Rye	1,695,000	23
Spring wheat	3,996,000	55
Oats	417,000	7
Barley	408,000	6
Proso-millet	296,000	4
Sunflower	124,000	1.5
Other crops	300,000	5

These figures indicate that about



FIGURE 16.—“Kompekovskaia” (*Atriplex canum*) steppe, as contrasted with the “Komplexnia” steppe.

ture formerly practiced in the Volga Region.

As was noted above, early spring grains, and particularly early spring wheat, are the least resistant grains in this region to spring droughts. In the lower Volga area, which includes the provinces of Samara, Saratov,

93 per cent of the total crop area in 1926 was occupied by grain crops, the yields of which under the peasants' methods of farming depend upon the rainfall in the spring and early summer (April, May, and the beginning of June). If there is no rain, there is certainly to be a short crop or a

complete failure. The higher the temperature and the less the rain during the month of May, the more certain is the crop failure. If timely rains fall in May, the yields of grain on peasant holdings are almost assured without any special effort.

This characteristic uncertainty of the crop yield on the peasant lands is well known to all the peasants in the dry Volga Region. Knowing their dependence on the weather during the spring, many of the peasants found it possible and profitable to insure themselves against ruinous crop failures by providing a surplus of grain for themselves, and of hay and fodder sufficient for their cattle for two or three years.

With a large area of steppe (grazing) land in the Volga Region, and a small population, a large acreage of sown crops per farm was possible in the past. Gradually the population increased, and the crop area per peasant holding had to decrease. Economic and social conditions associated with war and revolution still further reduced the acreage per homestead, and the people were forced to consume the reserve supply of grain and fodder. With this reserve gone, the drought was felt more keenly than in the past, and in many cases it meant either starvation or abandonment of the homesteads.

THE WAY OF ESCAPE

Notwithstanding the adverse climatic conditions, two of the old provinces, Samara and Saratov, exported annually during the last five years before the war about 20 million quintals of grain (73 million bushels). From Samara the average yearly exports were 2.2 million quintals rye, and 12.3 million quintals wheat, and from Saratov 1.6 million quintals rye

and 3.1 million quintals wheat. It is true that there were favorable crop years during this five-year period; however, one year, 1911, was very bad, and we can consider the surplus production of these provinces during



FIGURE 17.—First-year alfalfa planted in wide drills to conserve the moisture necessary to a good stand. When the roots penetrate deeper, the alfalfa can sustain itself well.

this period as typical of the pre-war years.

At the present time such a surplus does not exist, and agriculture has lost some of its stability. Naturally, one is prompted to ask, "Would it not be best to return to the pre-war conditions and thus make everything more satisfactory in the Volga Region?"

The suggestion seems simple but is impossible, and even if possible, it is better to go forward, guided by scientific knowledge, toward a rational agriculture. The crisis of pre-war agriculture in the Volga Region pointed out quite definitely that its organization was contrary to the natural conditions, as well as the changing economic conditions even before the war demanded a radical

adjustment in the methods of agriculture. War, revolution, and the resultant changes in social conditions showed still more clearly the unsuitability of the prevalent methods of agriculture, and thus the problem of establishing a more stable agriculture in the Dry Region was placed before its people.

MEASURES FOR OVERCOMING THE DROUGHT

"The granary of Russia," and "the region without a future" are the two contradictory characterizations of the dry Volga Region which have been used by statesmen and technicians. During the twenty-year period from 1891 to 1911, there were in Saratov and Samara Provinces, according to the Central Statistical Bureau, three complete crop failures (1891, 1906, 1911). During this period poor yields were noted ten times in Saratov and five times in Samara, particularly in winter and spring grains (1892, 1899, 1901, 1905, 1908), and three poor crops for either winter or spring grains (1895, 1897, and 1907). In other words, in Saratov out of the twenty-year period there were only five years with good crops (1894, 1896, 1900, 1904, and 1909), and in Samara there were only ten years of good crops.

In 1924 the total gross crop in Saratov, despite the increased area, fell to 2.5 million quintals. In six counties of this province the yield during that year was so small that the crop, after deducting grain needed for seed, amounted to less than one quintal per person. In 1904 the gross crop of grain in the former Saratov Province was equivalent to 18.7 million quintals; in 1899 it reached 20.2 millions; and in 1913 23.3 million, with an average for the

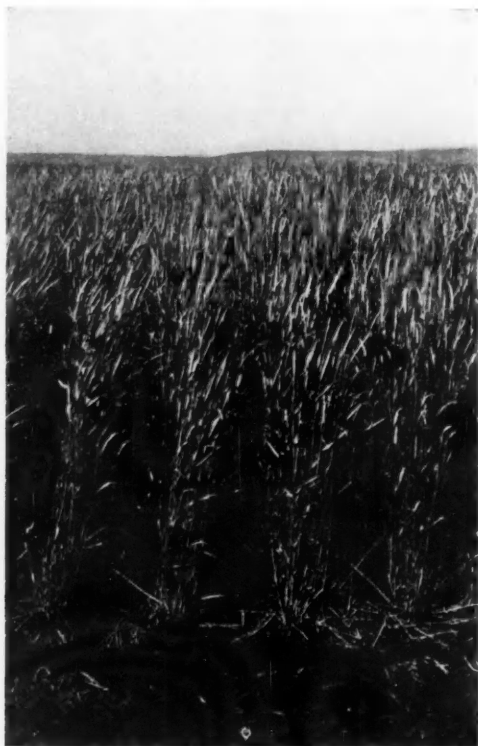


FIGURE 18.—Winter rye drilled with wide spaces between the rows. This crop occupies second place in the crop economy of the Dry Regions, and the technique of growing it is highly developed.

decade of about 13.5 million quintals. In the present boundaries of this province the average yield from 1910 to 1914 was equivalent to 9.94 million quintals. Considering the organization of agriculture that existed in the Volga area at that time, could anyone doubt the optimists who declared that this was the "granary of Russia"? Could anyone believe the statement that the region had no future?

But it must be recalled that public assistance in years of poor crops, and tremendous exports in the years of good crops, were characteristic of the Volga area in the past as well as the present. It is clear that for many years the organization of agriculture in the area has not harmonized with

the natural conditions. As previously noted there is a preponderance of small grains, which depend on occasional spring rains that frequently do not occur. This undependable cropping is carried on by very primitive methods without any attempt by the peasants to employ national methods of tillage which would in-



FIGURE 19.—Oats, drilled like all other grain and forage crops, in widely spaced rows.

crease considerably the yield of the crops.

The farmer in this Dry Region always has risked his livestock as well as his crop. Frequently there is insufficient fodder. The stock has had to be sold during droughts for a very small sum, and this has brought great hardship to the farmer. The only method of insuring against bad years or crop failures was to leave a sufficient supply of feed for stock and sufficient grain in the bins for food for one or two bad years. What would such insurance cost the individual farmer or the government? Could this assure the permanency of the agriculture of the area? The experiences of the past years are adverse to such methods of insurance. While such insurance would save the strong and well-to-do peasant, it would not help the poor peasant much, and the preservation of the poor peasant and

his holdings would have to be undertaken by the government, as has been often the case in the past.

Another type of insurance against the terrible results of drought and crop failures has been proposed—the creation of irrigation districts, where every peasant would be guaranteed a minimum crop for his sustenance during dry years. Without discussing whether it is possible, from the standpoint of availability of irrigation water, to provide all the population in the dry Volga area with irrigation, without touching the question of the cost of such projects, and without raising the principal question of whether this irrigation would provide the necessary insurance, let us consider a third plan of insurance. This proposal is to create in the area a correctly organized and technically adequate type of agriculture which in its organization and technique should utilize advantageously all the complex natural conditions. It is believed that in such an organization lies a permanent and profitable agriculture.

The Soviet Government has appropriated 77 million rubles, and a beginning has been made in this colossal undertaking of reorganizing the agriculture of the dry regions on the basis of the data provided by the local agricultural experiment stations.

IMPROVED TECHNIQUE OF TILLAGE

The experiment stations and other institutions have been working mostly on problems of local farming methods. Research in animal husbandry is not so extensive. The fundamental question in crop experimental work in the Dry Region is the amount of soil moisture and the best methods of its utilization. The determination of the most efficient



FIGURE 20.—In widely spaced rows, proso-millet is also drilled rather than sown.

methods of accumulating, storing, and using every drop of moisture is the principal goal of all the experimental work in field crops.

The methods are different in various sections, depending on the quantity and character of the precipitation. In studying these methods it was necessary to study the plant life and the way in which the plants utilized the soil moisture. It is well known that there are plants that cannot fully utilize all favorable conditions when offered, and, on the other hand, there are plants which repay the cultivator by increased yields. These plants must be found. If they are not indigenous, they must be introduced, bred, and selected after thorough study of the original plants. This is the great problem of the breeders in the Experiment Station.

The most important crop in the dry Volga area is spring wheat, the area of which in 1916 was 55 per cent of the total crop area. The average yield of spring wheat in the various

provinces of the Volga area for the last thirty years before the war varied from 4.3 quintals per hectare (6.3 bushels per acre) in Samara to 5 quintals (7.3 bushels per acre) in the Don Province. In Samara Province the extremes in yields in different years varied from one quintal per hectare average for the province during a year of crop failure to 8 quintals per hectare in years with good crops. In Saratov Province, with almost the same average of 4.5 quintals, the extremes were from 1.5 to 9.5 quintals per hectare (to convert to bushels per acre multiply by 1.47).

The experiment stations in the Volga area have devoted most of their time to spring wheat. Numerous experiments with this crop at the various stations have proven that the average yield of spring wheat could be raised by simple methods to nine quintals per hectare in the greater portion of the lower and central parts of the Volga area. In the drier southwestern portions of this area the average yield cannot be raised higher than 7.5 quintals, but in the northern and northwestern parts and in the center of the province the yields could average 10 or 11 quintals. For example, at the Saratov Experiment Station during the six-year period from 1916 to 1921, the average yield of wheat sown after several crops varied from 10 quintals after wheat to 13 quintals after pumpkins, and at the Krasnokutsk Experiment Station, located in a less favorable climate, the yield for five years from 1914 to 1918 varied from 6.3 to 7.6 quintals per hectare. The yield of spring wheat can be almost doubled by simple methods, which are within the reach of every peasant.

As mentioned above, the area of spring wheat in the Volga area in

1916 was about 4,000,000 hectares (10,000,000 acres). Supposing that all the farmers of the Volga area would grow spring wheat according to instructions of the local Experiment Station, and that instead of the average yield of 4.6 quintals per hectare, they would obtain 8.2 quintals per hectare. This increased yield of 3.6 quintals per hectare would produce about 15,000,000 additional quintals (55,000,000 bushels) of grain.

was very variable, and that yields at times approached zero. This is owing largely to the primitive methods of cultivation, which do not utilize the comparatively large amounts of rain which fall during the fallowing of the land, as well as during the growth of the crop.

The experiment stations have devoted considerable time and attention to the study of the preparation of the fallow for winter grain. It is definitely known that winter rye is



FIGURE 21.—The less densely planted corn to the right, the more closely spaced corn to the left, indicates how this forage crop responds to the small supply of moisture in the soil.

The second grain in importance in the Volga Region is winter rye, the area of which in 1916 was about 1,700,000 hectares. The average yield of winter rye in the Samara Province for the last thirty years before the war was 3.7 quintals per hectare, and in Saratov Province, 4.6 quintals. The minimum average yield of rye for Saratov Province was 0.5 quintals, and the maximum, 9 quintals. The difference between the extremes in the Province of Samara were not quite so great, but it can be seen that the acre-yield

well adapted to the climatic and soil conditions of the Volga Region, and the results of the different methods of cultivation are definitely established. The average yield at all the experiment stations of the Volga Region is 16.9 quintals per hectare. Taking the average yield of winter rye on peasant holdings at 5.2 quintals per hectare, the average yield of the Experiment Station is three times greater. Supposing that every hectare would have an increase of only ten quintals, the possible increase of the crop of winter rye over

the present yield on the area devoted to this crop would amount to 17 million quintals. These rough estimates, of course, are subject to error, but they show clearly that the technical possibilities of this region are unusually promising. The correct methods of culture of only two of the most important crops in the region could make an enormous increase in their production, and at the same time assist greatly in increasing agricultural stability.

But the experiment stations also have data on hand which prove that the farmers of this region can depend upon other crops. The principle climatic obstacles in the dry region consist not alone in the absolutely small quantities of precipitation during the year, but even more in the irregular and capricious distribution during the period of plant growth. For instance, the rain often falls after rye and wheat have completed their growth, and thus is useless. Not only are these rains useless to these crops, but also to crops in general, since there are no crops grown by most farmers which could utilize the precipitation at this time of year. The experiment stations, in studying the various cultivated plants of the dry regions, discovered a number of crops which, after being planted in the spring, grow all summer and mature in the fall, thus utilizing the late rains. These plants are usually planted with a wide space of land between the rows, which, during the summer, are frequently cultivated to destroy the weeds; consequently they are called "cultivated" or "row" crops. This group of plants is quite diversified, but are similar in having a long period of growth, and in being able to utilize the rains which usually occur in sufficient quantities during



FIGURE 22.—Indian corn constitutes a most important crop over much of the dry-farming area, drought resistant varieties yielding relatively well, and affording both forage and grain resources that are invaluable to the peasants.

spring, summer, and the first half of autumn.

For example, let us take proso-millet or corn. These crops, planted in the last days of April or early in May, grow very slowly, as they require a considerable amount of heat for their development. As these plants develop slowly at the beginning, they are not greatly injured by early spring drought, and utilize to good advantage the moisture and warmth of the soil. As was noted previously, the drought is commonly broken by rains in June or July. Proso-sorghum and corn utilize these summer rains for their rapid development and continued growth. Corn can even utilize the August rain

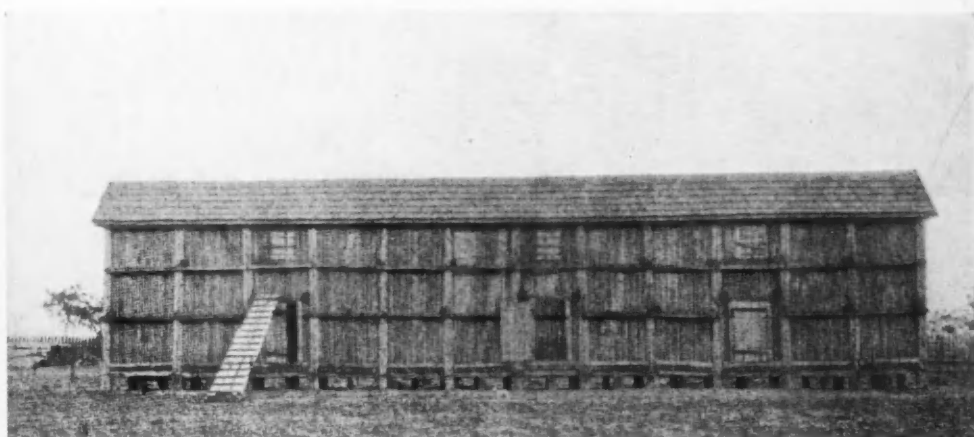


FIGURE 23.—A typical corn crib in the sections where maize can be grown advantageously as a grain crop.

which as a rule can be depended upon. The yield of corn in the Volga Region Experiment Station varies from 18.5 to 22.5 quintals per hectare, and is sometimes even higher, but the yields of the proso-millet usually average only 15 quintals per hectare. The importance of these "row" or intertilled crops to the agriculture of the Volga area is illustrated by crop yields during recent years, particularly in 1924. With an almost complete failure of spring grain on the adjoining peasant fields during that year, the crop of proso-millet on the field of the Saratov Experiment Station yielded 16.5 quintals per hectare, and the yield of corn was 15 quintals.

There are other crops of promise. A little smaller yield is produced by sunflowers, which also have a long vegetation period, but the yield frequently depends on other causes than the weather. However, the sunflower is well adapted to this region. A whole series of cultivated root crops, mangles, carrots, potatoes, etc., and vine crops, such as pumpkins, watermelons, and cantaloupes, have the same long-season

growth characteristics, as do corn and proso-millet. They can utilize the summer rains and heat and do not suffer much from spring drought. Some difficulty arises, however, in obtaining strong germination of mangles and watermelons, if the spring is too dry, but this is not an unsurmountable difficulty and does not prevent the growing of these crops.

As regards forage crops, the experiment stations in the Volga Region paid considerable attention to both perennials and annuals, to those which provide succulent feed during the summer and to those that provide hay during the winter. Investigations were carried on with alfalfa, brome grass, and many other perennial grasses, notably the sorghums, sudan grass (recently), mogar, corn as fodder and as ensilage, winter rye for fodder, and various mixtures of vetches. The main object of investigation was to find such plants as would utilize the precipitation of the entire vegetation period. This was found to be best achieved by a combination of perennial and annual forage plants. The results thus far



FIGURE 24.—West of the Volga, the sunflower, high in oil content, has become an important crop and yields itself well to the specialized dry-farming technique.

obtained in the experiments with forage plants give hope of a well-regulated field and animal husbandry in the Volga area.

PLANT SELECTION

Selection and development of drought resistant strains of a crop are necessary as well as the adaptation of crops and grasses to the Dry Region conditions of drought and moisture. The long-continued experiments of the Saratov and Bezenchuksk Experiment Stations, as well as of the Krasnokutsk Experiment Station, in the selection of varieties of winter and spring wheat, sunflower, and proso-millet, have given excellent results, and strengthened greatly the belief in the possibility of establishing in the Volga area a permanent and profitable agriculture.

The Saratov Experiment Sta-

tion has developed a new variety of soft spring wheat, white, beardless Lutestzes No. 62, which has given during the last ten years considerably higher yields than the usual type of a local spring wheat called "Poltavka." The Krasnokutsk Station has developed a splendid type of hard, high-yielding wheat for the sod land of the far Volga area. Another extensively used variety which was developed by the Saratov Station,

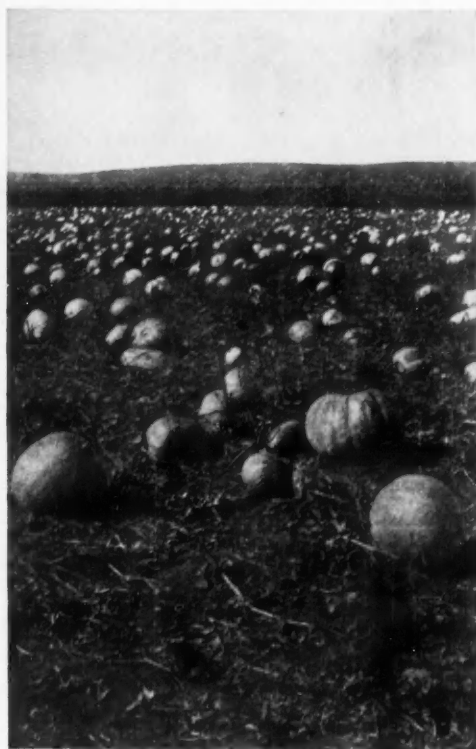


FIGURE 25.—Pumpkins, like sunflowers, fit readily into the dry-farming scheme, and furnish large quantities of valuable stock feed in the Dry Regions.

and which can withstand many of the rigors of spring and early summer, is the winter wheat No. 329.

The selection of sunflower also produced excellent results. The Saratov Experiment Station bred and distributed for mass production a



FIGURE 26.—Machinery is rapidly being introduced on a large scale into the dry-farming technique of the dry regions, the more extensive type of agriculture thus made profitable bringing into cultivation great areas where intensive cropping is out of the question. Grain drills, like these illustrated, form one phase of this machine progress.

variety of well-producing sunflowers resistant against some of the most important enemies of the crop in this region. Excellent work in selection also has been done with perennial forage crops, particularly yellow-flowered alfalfa and *Agropyron* (*Triticum*) *cristatum*. This work has furnished the peasants of the dry Volga area with good yielding forage crops of high quality.

BETTER ORGANIZATION OF AGRICULTURE

The information in possession of the experiment stations on methods of cultivation of various crops enables them to outline definite plans of agricultural organization which will correspond to the natural conditions of this region and permit maximum utilization, particularly of precipitation.

The Volga area is so large, and natural conditions so diverse, that it is impossible to outline one common system of farm organization which would be applicable to the entire area. In the extreme eastern and southern part just outside of the isohyet of 250 millimeters of annual precipitation, crop production cannot play an important part because of the

deficient rainfall, and stock-raising in its various forms will have to remain for a long time the principal occupation of the inhabitants. For this kind of agriculture it is necessary to have a supply of winter fodder, without which the stock often perish, and this requirement of the stockmen must be taken into consideration in organizing the agricultural system. The supply of fodder must be provided by growing fodder crops on a large scale in the more suitable lands, or by utilization of the meadows, sometimes improving them by artificial irrigation. These are questions that will have to be decided locally; but even for this section of the Dry Region the methods of improving the fodder yields have been sufficiently demonstrated to furnish the local agricultural adviser with basic information. In other parts of the region, grain growing will remain the main industry of the population, but with it must be developed stock-raising, not in such primitive forms as are used in the dominantly arid districts, but in more complex forms, involving closer correlation between grain growing and stock-raising.

It has been pointed out that the great variations among the cultivated



FIGURE 27.—Both oxen and horses are utilized as draft animals, both having their advantages and disadvantages.

plants in their utilization of warmth and moisture at various times of the vegetation periods make it possible and even necessary to raise such crops as will grow during a long period and utilize for their development the warmth and moisture of the second half of the summer. Such plants are found mostly among the fodder plants, but there are also several in the group of so-called "industrial" plants. The farmer

To combine the growing of field crops with stock-raising it will be necessary to work out in detail systems of farm organization for various sections of the region. It may be found, of course, that in some sections of the Volga area the main income of the farm will be the selling of hard wheat, and livestock will be kept on the dry fodder from the wheat fields and on the native perennial grasses. The livestock will



FIGURE 28.—Threshing in the field with modern machinery, an outfit not unlike those of the great grain empires of the American Northwest and Canada.

should, therefore, grow a variety of crops, and for the proper utilization of the fodder crops the farmer must include a system of stock-raising. The stock should be fed not only on the natural pastures, but also on the crops which are harvested from the fields.

provide sustenance for the farmer and will act as insurance against the years when the yields of grain crops are very low. In other sections there is hope of establishing a great variety of crops, particularly cultivated crops such as roots, potatoes, corn, sorghum, and other products



FIGURE 29.—Cattle form one of the dependable features of the dry-farming landscapes, for grazing on the lands least adapted to cropping must supplement the dry-farming economy.

which can be used for silos. The growing of perennial fodder crops may not prove profitable here owing to the lack of land, but in place of them the annual fodder plants can be grown. The latter give an opportunity to establish a better and more suitable crop rotation; and, on the whole, will produce fully as good quality of crops as the perennial plants.

The systems of stock-raising in these sections will be different. While

area, the program of crop diversification will be directed toward industrial crops, such as sunflowers, potatoes, and, in some places, sugar beets, together with forage crops grown in rows. The growing of industrial crops should play an important part in the local agriculture. The correct methods of growing industrial crops have a great influence upon the organization of agriculture, and constitute one of the

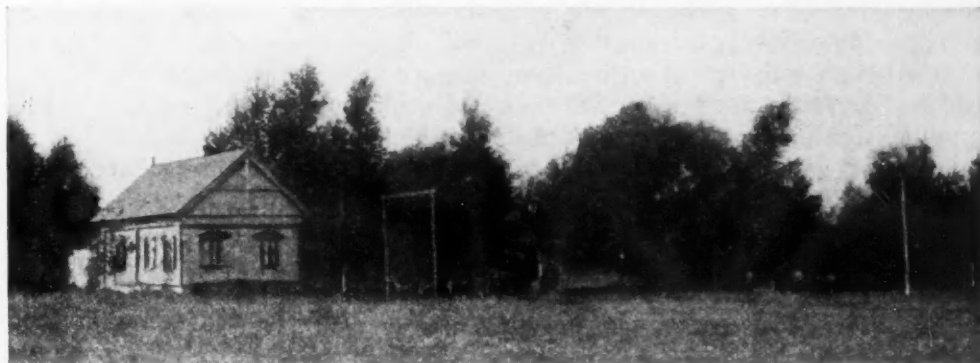


FIGURE 30.—A typical scene in the dry-farming regions where by careful choice of site and attention to growth a hospitable grove shelters the buildings.

in the sections with dry fodder it is natural to raise beef cattle and only occasionally dairy cattle, in the section where the root crops and green fodders are raised it may be expected that the development will be toward dairying and also hog-raising.

In other parts of the lower Volga

most important factors in its prosperity. As the processing of these industrial crops is usually done within the province where the products are grown, the by-products from these crops, cakes, meals, and pulps, can be utilized on the local farms, and thus increase the supply of fodder.



FIGURE 31.—Grain binders on the way to the harvest, showing how modern machinery is invading the steppe agriculture and extending the crop-growing areas.

STOCK RAISING

Sufficient data are at hand to warrant the assertion that stock-raising in the dry region should receive most serious attention, and especially the relation between field crops and livestock should be worked out definitely and in detail.

From the standpoint of the local agricultural organizer, the advantages of the region in livestock production are notable: (1) The forage crops are very suitable for stock-raising and the great extent of steppes provides vast pasturage. (2) Although the vegetation is often parched by the summer's heat, the quality is excellent, and the summer rains usually cause the vegetation to revive rapidly and supply green pastures during the fall months. (3) In the eastern part of the far Volga area, there are numerous natural meadows, at times covered with water, which could supply enormous quantities of hay with a comparatively small expenditure of labor for its preparation.

Organization of the production of livestock on a large scale for meat on the steppes of the far Volga area will be possible only when proper facilities are provided for the handling and shipping of meat products to large cities in the Union, and also for

export. It will be necessary to have an adequate system of transportation, not primarily for the transportation of livestock, as was done before the war, but of the products of the slaughter houses located where the cattle are raised and fed. In order to accomplish this, it will be necessary to build suitable slaughter houses, refrigerators, packing and canning establishments, also make provision for complete utilization of all by-products—in brief, create such an organization for the industry as will assure maximum utilization of the stock where it is raised.

Conditions in the Dry Region are particularly well adapted to horse breeding, which was quite extensively practiced there in the past. Cavalry horses of the Don and Ural Provinces were the natural products of the steppes, and there is no reason to suppose that this type of animal will not be reestablished in the near future.

At the present time, the demand for dairy products is developing rapidly, and to satisfy this demand dairy farming is increasing, particularly in the vicinity of large cities.

Closely related with dairying is swine culture which has possibilities for development in the future. The development of these two branches of

animal husbandry is favored by the abundance of bran and cake in this area. The existence of large flour mills and oil pressing establishments afford the farmers an opportunity to secure comparatively cheap concentrated feeds, which are used to such advantage by these two types of animals.



FIGURE 32.—Shorthorn-Kalmitzki ox, three years old, a variety used both for draft and beef.

RÔLE OF LAND SETTLEMENT

In order to reorganize agriculture in the region, it is first necessary to have sufficient land suitable for settlement. The possibility of improving the methods of cultivation, of introducing new crops for stabilizing agriculture, of reclaiming larger or smaller areas of land—all these are only possible when the settlers, whether as individuals or groups (collectives) have every opportunity to experiment with new methods.

The very large villages (congregated farm settlements) of the Volga area, which were formed partly on account of lack of water in the steppes, and partly on account of peculiarities of the population in the distant past, have large areas of land available for cropping. The peasants waste a lot of valuable time going to and from the fields and barns during the planting and harvesting season.

The distance of the fields from the homes of the peasants is the peculiar characteristic of the Volga area. In the more thickly settled sections, the land is subdivided into small fields (in order that the various types of lands should be equally divided among the peasants). Both these circumstances interfere with the correct organization of field husbandry. A very important interest of the agronomists is this problem of land subdivision.

The various forms of land settlement have developed out of actual experience and depend on natural conditions of the locality and social environments. In the Dry Region the most important part of all the work of reorganizing agriculture will be the bringing of the population closer to the land which it works, and in many localities the question of proper water supply also is important. In fact, the problem of water supply usually takes the front rank in all projects for land settlement and subdivision in the Volga area.

AMELIORATION OF CONDITIONS

Immense areas of the lower Volga area have been divided into amelioration districts, in which nature itself, as well as the agricultural conditions, point toward entirely different possibilities of amelioration. In a very large portion of the lower Volga area, the water supply is so limited that amelioration by irrigation becomes insignificant, but a considerable extent of land may be ameliorated through the utilization of spring precipitation on the natural meadows. A small portion of this ameliorated land may be utilized for the growing of spring grains.

In the section with a small amount of precipitation (about 300 milli-

meters a year) where yields of grain crops under the usual field tillage are uncertain, there is a possibility of constructing water reservoirs. These irrigated lands could be utilized for garden and orchard crops for home consumption. However, according to the conclusions of irrigation ex-

utilization of the snow which is usually blown off during the winter into ditches, villages, and other obstacles in the steppes by the constant winds, must not be ignored. Notwithstanding the meagreness of the snow covering, the proper utilization of the moisture in the snow would be of greatest benefit in crop production.

CONCLUSION

The natural and agricultural conditions of the dry Volga area are very similar to the conditions of the dry areas in other parts of the Union of Soviet Republics, and schemes of agricultural organization in these various dry sections can be adopted as soon as these schemes are successfully worked out in a part of the Volga area, where conditions are similar. It is, of course, impossible to transfer mechanically the plan and organization of the agriculture of the individual parts of the Volga area to other sections. It will be necessary to make a preliminary comparison in detail, of the natural conditions, the perspective of agriculture, and the economic situation in every individual case. In particular, there is reason to believe that the reorganization of agriculture in the Volga area will serve as an example in planning new, more perfected forms of agriculture for extensive areas in the Asiatic portion of Soviet Union. The plans purpose to achieve full coördination with the natural conditions and with the demands of the rapidly developing peasant farming. The aim is to utilize fully the natural resources of the region for the increase of the prosperity of its inhabitants.

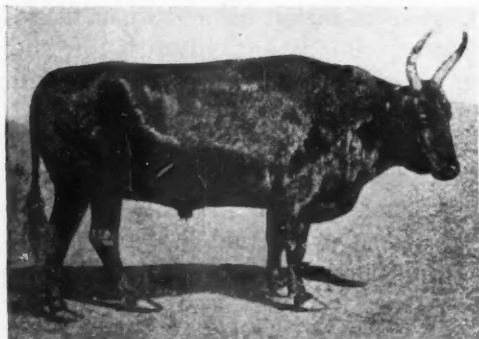


FIGURE 33.—Kalmitzki ox, seven years old, illustrating the sturdy, well-developed type widely distributed over the steppes.

perts, such amelioration measures in the lower Volga cannot become important except as they influence the permanency of agriculture.

Necessarily the main form of agriculture in the vast extent of the Volga area will be dry farming, at least for many years; but the organization of agriculture in which proper attention will be given to the correlation between field crops and animal husbandry will, in due time, bring irrigation in those places where it is possible and profitable. Such irrigation may lead to the development of other branches of agriculture, which will in the end strengthen the whole system of organization and enhance the prosperity of the farmers.

While speaking of amelioration possibilities in this area, the so-called "snow amelioration," that is, the

THE GERMAN SUGAR BEET INDUSTRY

E. Muriel Poggi

Geographer, University of Illinois

THE world's sugar supply was drawn chiefly from the cane-growing countries of the tropics until the middle of the last century. No special interest was attached to the sugar beet till the publication, in 1747, of Marggraf's pamphlet in which he set forth his discovery that the beet contained sugar. In 1799 Archard, a pupil of Marggraf, presented the king of Prussia with a few pounds of sugar which he had produced from beets, with the result that in 1801 the king financed, for him, the erection of a small factory in Silesia, the first beet sugar factory in the world. It was to Napoleon, however, that the development of the beet sugar industry was largely due. During the European wars of 1800-1815 there was a great shortage of sugar in Western Europe owing to the embargo on the West Indian product. Napoleon offered the first government bounty on beet sugar in 1806; in 1811 he issued a decree to put 79,000 acres of French land into beet cultivation and started the industry off on large-scale operation.

The production of beet sugar increased so that its proportion of the world's sugar crop rose from 14 per cent in 1853 to 65 per cent in 1900. In 1853 the beet sugar production was only 202,000 tons as against 1,260,000 tons of cane sugar. At the beginning of the World War the production of sugar beet was

8,908,000 and the cane production 9,879,000 tons.¹

Early in its history beet sugar became an important rival of the cane product. The race between the luxuriant perennial cane of the tropics and the carefully cultivated beet of the middle latitudes has been an interesting contest during the past 80 years (see Fig. 1). The leading place was won by beet sugar in 1883. Occasionally after this cane sugar forged ahead but did not hold the lead before the World War. The chief European governments used bounties, drawbacks on exports, and other measures to encourage the producers of beet sugar and thus enabled it to supersede cane sugar in Britain—the largest import market. The effect on the West Indian industry was disastrous. Finally, the principal Western European governments agreed, under the terms of the Brussels Convention of 1902, to do away with the artificial aids to beet production and the industry was forced to "stand alone." Figure 1 shows the trend of sugar production. Beet sugar, stimulated by bounties and tariffs, was approximately equal to cane production from 1884 to 1914. Since 1914 cane sugar has continued to increase while beet declined in relative importance to less than one-third of the total sugar supply of the world in 1922. It

¹ Schneider, F., "Sugar." *Foreign Affairs*, Vol. 4, No. 2, Jan., 1926, p. 313.

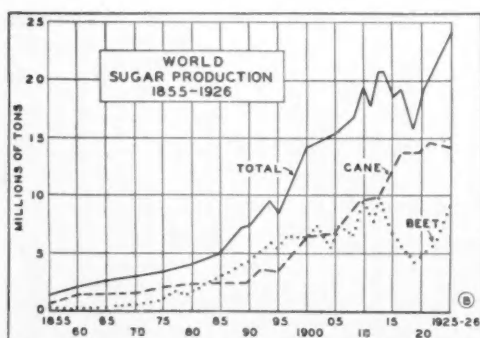


FIGURE 1.—The production of cane and beet sugar was about equal in 1913; then the beet production dropped and continued to do so until 1918. During the war the cane production increased steadily. It was not until 1927 that the cane and beet curve began to approach each other again. (Figures from Yearbook, U. S. D. A., 1923, and International Crop Report, Rome, 1926.)

must be remembered that the countries that grew sugar cane were affected least by the War and their production progressed unhampered. The countries producing beet sugar were so located as to suffer severely under war conditions, especially the three chief exporting countries—Germany, Russia, and Austria-Hungary. This is clearly shown by the following figures showing their beet sugar output for two significant years:² 8,750,000 tons in 1914 and 3,610,000 tons in 1918.

About 1919 the production of beet sugar began to increase substantially (Fig. 1) and the figures for 1925–1926 show that the industry is nearly at its pre-war level. The economies of large-scale production of cane sugar by American Corporations in the West Indies, however, will force beet sugar interests in Europe to the highest efficiency of production if they are to compete in the export field with cane sugar.

Since 1899 the output of cane sugar has steadily increased. The

² Simpich, F., *Commerce Reports*. Vol. 23, April 17, 1920, p. 339.

same cannot be said of beet sugar. If the merchant realizes that the available quantity of cane sugar is certain whereas that of beet sugar is uncertain, there is no doubt as to which of the two he will handle. The question, "Why is there a difference in the degree of certainty?" follows, naturally. The answer is a serious one for Germany. That both of these varieties are influenced by their climatic environment is certain. It is true that the sugar beet possesses a remarkable adaptability to various climates and soils; nevertheless, a world map showing the distribution of the crop presents evidence that climate still controls. This is Germany's largest handicap in its problem of beet cultivation. Cane sugar grows where labor is cheaper than in Germany. Its cultivation demands less attention and harvest-



FIGURE 2.—Steam plough and harrow on the beet field.

ing is a simpler and easier process than is the case with beets. In Germany the area possible for the spread of the sugar beet is limited. At present it is about as extensive as possible. The tropics are only beginning to be penetrated. Sugar cane has only been cultivated systematically for a few years; that the output of the latter is likely to sur-



FIGURE 3.—Drilling machine, horse- or mule-drawn except on the largest plantations where motor drills are the rule.

pass that of the sugar beet is quite possible if not probable.

The sugar beet is a native of Europe. It requires, for its best development, moist and fairly mild conditions with much sunshine for its vegetative period and a dry sunny autumn. Cooler weather is said to be best for the maturing season. Because of the necessity of a constant moisture supply during the growing period, soils of heavier texture are desirable. These conditions are found throughout Northern Europe from Northern France to Central Russia. Early in the history of the industry beets became an important crop in central Germany and Bohemia. Various reasons may be put forward for the success of the industry in these countries, among them, the German interest in chemical industries, the comparatively cheap labor supply and the fact that there is little room for pasturage and the people find it profitable to feed their cattle on the pulp that is left

after the sugar has been extracted from the beets. The industry has developed in areas in Germany where



FIGURE 4.—Thinning out the young beets. This work is done almost entirely by hand.

the population is dense and where, accordingly, the market is close at hand; where, too, manure is abundant or the advanced state of commerce renders it easily procurable.

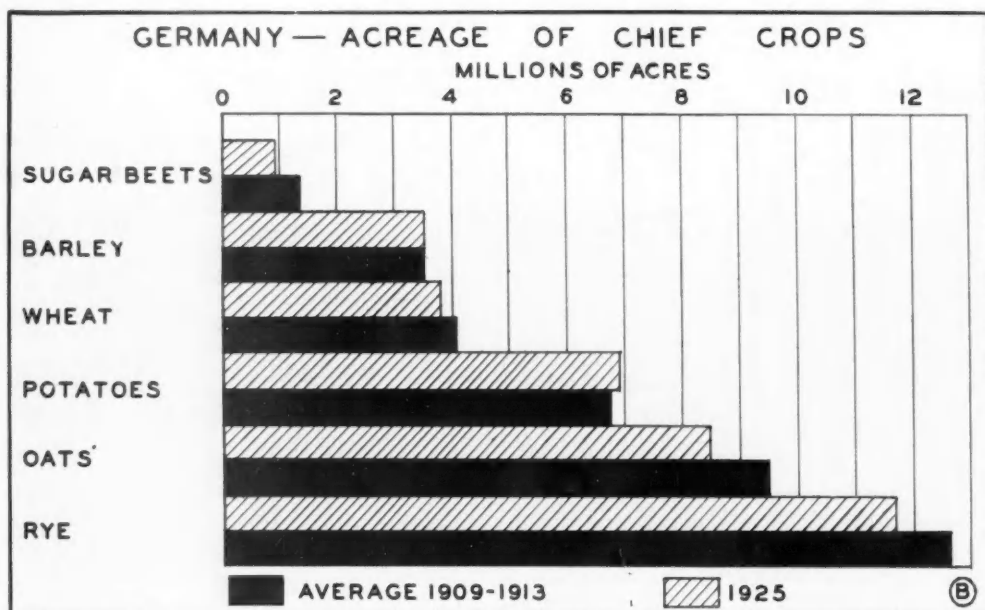


FIGURE 5.—The sugar beet is an intensive crop, hence the small acreage. Although there was a large surplus of sugar for export in 1913, the best occupied less than one-half the acreage of any other German food crop. (Based upon International Crop Reports and "World's Food Resources" by J. R. Smith.)

Capital is plentiful and consequently the low rate of interest on money favors the erection of the best ma-

chinery in the factories. The advantage of yielding a refuse material which is a useful manure (in adding

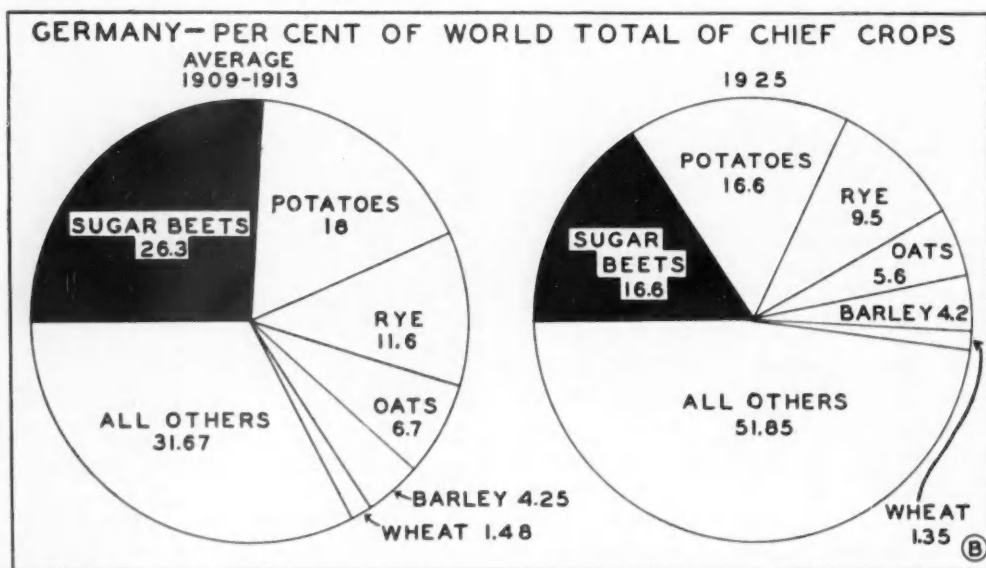


FIGURE 6.—In 1913 Germany produced more than one-fourth of the world's supply of sugar beet; this dropped to practically nothing during the four years, 1914-1918, but by 1925 she was supplying approximately one-sixth of the world total of beets. (Figures supplied by Bureau of Agr. Economics, Washington, D. C.)



FIGURE 7.—Hoeing between the young plants. Gangs of women frequently do this work, supervised by one man.

potash to the ground) and a valuable food for cattle is of special importance in thickly peopled countries. The mention of these conditions affecting the cultivation of the sugar beets enables one to understand why the plant cannot be cultivated with success in all parts of the world in which the climate is suitable.

To Germany is due a major part of the credit for the scientific studies by which the sugar-yielding qualities of the beet have been raised from 1 pound of sugar in 18 pounds of beets to 1 pound in about 6 of beets.

The beet acreage of the world is surprisingly small. With her large sugar export before the war (1,126,217 metric tons),³ Germany raised her whole crop on but $1\frac{1}{3}$ million acres of ground, 2,000 square miles, less than 1 per cent of her total area (Fig. 5).

These figures accentuate the fact that the sugar beet is essentially an intensive crop, which is another reason why central Germany, with its dense population, access to large supplies of chemical fertilizers, and

easy and cheap means of transport, should be especially suited for this crop.

The development of German agriculture during the last 40 years presents a striking illustration of what may be accomplished in a country whose cultivable area is sharply limited by natural conditions and whose expansion in production has been possible only by intensive cultural methods, the scientific use of fertilizers, and the closest attention to seed breeding.

The sugar beet ranks with the five most important crops of Germany—rye, oats, potatoes, wheat, and barley. Though the acreage under sugar beet is relatively small, its importance may be seen by consulting Figs. 5 and 6, which show the acreage under the six chief crops of Germany in pre- and post-war years and the per cent which the German production of these crops forms of the world total of each. From Figs. 5 and 6 it can be seen that although the sugar beet acreage was much smaller than that of the other important crops before the war (1909–1913), the German production represented 26.3 per cent of the world total of sugar beet, a much higher per cent than that of any other German crop. Fig. 6 shows that in 1925 the acreage has decreased, due somewhat to territorial changes, and the per cent of the world crop of the German sugar beet is only 16.6 per cent, but even then none of her other crops have a higher per cent of the world total, potatoes being the same as sugar beet and rye next, representing 9.5 per cent of the total world production.

There is a certain amount of interesting coöperation possible between the cereal farmers and the beet producers. Oats and barley are almost

³ Supt. to Com. Reports, *Trade & Econ. Rev.*, 1922, Germany, p. 3.

entirely spring-sown and this usually occurs before beet and potato planting. These two crops are planted almost simultaneously. Potatoes, at the time of planting, make greater demands than beets upon the labor supply, because of the cutting of the seed potatoes. The preparation of the beet seed bed, on the other hand, involves much more work than that of the potato seed bed. Once the crops are above ground, beets require many times more work than do potatoes, much of which is hand work. Cultivation of potatoes ends long before the painstaking hoeing and weeding of beets ceases. Potato harvest is usually complete before the beet campaign opens. Crops of oats, barley, and the fall-sown wheat and rye require no labor from the time of planting to the time of harvesting, and their harvest is past when the labor supply is needed for the beet campaign.

The beet sugar industry of Germany is confined chiefly to Saxony, Brandenburg, Silesia, Hanover, Pomerania, and the Rhine Provinces, though other provinces of central Germany are also producers as will be seen from Fig. 8. The cities of Magdeburg, Hanover, and Breslau are the chief centers of the industry; this is also brought out by Fig. 8, as the areas of heaviest production are seen to be around these towns. These three cities have the largest number of sugar factories: Magdeburg 90, Hanover 63, Breslau 34.⁴ Delitzsch, ten miles north of Leipzig, is also an important center and a large seed-breeding station.

A glance at the physical map suggests at once the reasons why these towns early became important for

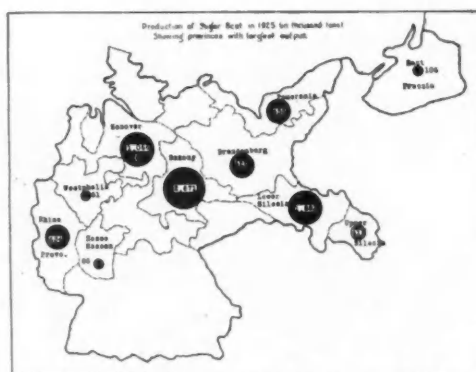


FIGURE 8.—Saxony, Hanover, and Silesia are the chief beet-producing provinces. In addition to the necessary physical conditions, a relatively dense population accounts for adequate labor supply and markets for the sugar. (*Statistisches Jahr Buch, 1926.*)

beet sugar. Each is on or near one of the great inland waterways of Germany—Magdeburg on the Elbe, Breslau on the Oder, and Hanover on a tributary (the Leine) of the Weser. Each has long been the nucleus of a densely populated area. Hence, there was in each case a large market for the product in the neighborhood, and easy and cheap means of transport for the surplus to be carried to the seaports for export.

Among the factors which influence the cultivation of the sugar beet, the environmental conditions of soil and climate are of major importance. The German portion of the European plain is only slightly above sea level, with occasional minor variations, remains of ancient moraines (most of central Germany having been heavily glaciated). The soil is chiefly of medium or light sand, excellent for rye or potatoes. In some districts a good loam prevails and in the river valleys a medium to heavy alluvial soil predominates. In the sandy soil of the plains, rye is the principal grain crop and potatoes the chief hoed crop, the richer loams being reserved for the sugar beet. When

⁴ Agricultural Survey of Germany, U. S. D. A. Bull., 1399. May, 1926.

considering the most suitable soils for this crop, Knauer, one of the great German authorities on sugar beet, says: "A loess soil with a smooth surface, slightly inclined to the south, as little stony as possible, rich in humus and very deep, on a subsoil, water-filled and non-pebbly, present the best conditions."⁵

In the sugar beet fields, the productivity of the soil is maintained by

the generous application of stable manure, but the crop in each case gave a lower per cent of sugar than was realized from land treated with commercial fertilizers, bearing the above-named constituents, and a lower per cent than was obtained from plots having no fertilizer application. Since the beet crop requires an abundance of lime as one of its plant foods, a calcareous loam of



FIGURE 9.—On many large estates in the Magdeburg district, hoeing is carried on by horse-drawn machines.

the application of artificial fertilizers, by the use of barn manure and by crop rotation. The sugar beet is not so exhaustive to the soil as corn, wheat, and tobacco, but more so than potatoes, beans, and grasses. Beets, being heavy consumers of nitrogen, potash, and lime, naturally respond profitably to the application of these fertilizers, which not only increase the tonnage of the beets but also the per cent of the sugar. The highest tonnage yields have been obtained by

strong clay admixture seems best adapted from the standpoint of plant foods and fulfills the physical requirements.

The European beet farms are almost always well cared for because the beet manufacturing companies, to assure themselves of a good supply of beets, insist, in their contracts with the grower, that a certain rotation of crops shall be followed. Furthermore, the care and fertilizing required by the beet, leaves the field in excellent condition for the production of small grain. This rotation results

⁵ Knauer, F. "Der Rubenbaum," 1906, *Bull. Amer. Geog.*, Vol. 47, p. 248.



FIGURE 10.—Beet field before the harvest.

in such increased yields of grain per acre that it is said that the addition of beets to the crop rotation has not reduced the total grain of the beet districts.

Different crop rotation is practiced in different localities. In Upper Silesia, for instance, where the soil is rather heavy, No. 3, shown in the table below, works best. In more sandy regions, No. 2 gives the best results.

TABLE 1
CROP ROTATIONS USED IN SUGAR BEET CULTURE *

1	2	3
Sugar beets, potatoes, oats, barley, rye (winter), wheat, sugar beets.	Sugar beets or potatoes, barley or oats, sugar beets or potatoes, potatoes, barley or oats, clover, sugar beets.	Sugar beets, barley, rye, red clover, sugar beets, barley or oats, cereals (in variety), sugar beets.

* Van Cleef, E., *Bull. Amer. Geog. Soc.*, Vol. 47, p. 249

In considering climatic conditions, as far as temperature is concerned, experiments have indicated that beets attain their greatest perfection in a zone of varying width, through the middle of which passes the isotherm of 70° F. Beets require a long day with plenty of sunshine during the growing season. Abundant moisture is needed in the early stages of growth to insure roots of good size, and this should be followed

by a period of less rain, more sunshine and cool nights for the development and storage of sugar.

In Europe the sugar beet is usually sown in April and harvested in September. Planting takes place as soon as the ground is free from frost. One kilogram (2.2 lbs.) of seed should produce about 70,000 plants in rows 14 inches apart, and plants 10 inches apart in each row. Though it is sown to the depth of only 2.3 centimetres, the soil must be deep. There is practically no time between the day of planting and that of harvesting when the sugar beet needs no attention. Just as soon as the plant appears above ground the work of cultivation begins. In order to produce the largest yield of beets, intensive culture is essential. Much of the work can be done by machinery, but the early cultivation and thinning must be done by hand and with the hoe. The German peasants have the idea that they hoe sugar into the beets, and this is not far from the truth, since on the same quality soil the sugar content varies from 10 to 18 per cent depending on the method of cultivation. At harvest time the soil is loosened around the roots by running suitable ploughs along the rows, after which the roots can be "lifted" or "pulled" by hand. After lifting, the crowns and attached leaves are cut off and the roots sent to the factory. Here they pass through mechanical "washers" which remove all adhering soil and stones and the clean roots pass to the weighing machine. The beet grower is paid on a basis of this "true" or "net" weight, which is very much less than the gross weight transported from the field to the factory. The tonnage of clean roots per acre varies considerably in different countries,

according to the variety of beet cultivated and also in any one country in different years according to the rainfall. The following figures show the tonnage per acre in the chief sugar beet-producing countries of Europe in 1913.⁶

TABLE 2

Country	Tons per Acre
Germany	14.2
France	10.6
Belgium	11.8
Czecho-Slovakia	12.7 (1914)
Russia	6.0

Upwards of 100,000 people are permanently employed in the sugar beet industry in Germany. These laborers are primarily women, girls, and children—family labor. The thinning of the beets as well as its cultivation is done largely by women. Their wages are about 60 per cent that of men. It is estimated that the labor needed to produce an acre of beets is about 10 times that required for an acre of wheat. Many "season" workers or immigrant laborers are brought to the work from Russia, Hungary, and Poland. This seasonal migration of labor was at first a small one from the east, to take care of Saxony's sugar beet crop—the term "Saxon Ganger" is an old one. Such labor was not imported only into Saxony, but it also reached the Central and Northeast territory. As many as 400,000 Poles yearly migrated to Germany before the war. They returned to Poland after the harvest; in fact, by law, these immigrants must be returned to their own countries by November 15. With regard to the present labor supply, the sugar factory industry is beginning to "dovetail" into the beet-growing industry and this should be the means of maintaining the resident labor supply in the sugar beet areas

⁶ U. S. D. A. Bull. No. 987, Handbook of Foreign Agricultural Statistics.



FIGURE 11.—Magdeburg, Hanover, and Breslau have the largest number of factories. Each of these cities is on or near a great waterway, and each is the center of a densely populated industrial area. (Figures supplied by U. S. Bureau of Agr. Economics.)

all the year round. The factory industry is essentially a seasonal one, being carried on only for three or four months, during the winter, after the beets are harvested. It accordingly will provide employment in country districts at a period when agricultural employment is slack.

The distribution of factories, including refineries, in Germany in the season 1924-1925 is shown in Fig. 11, the total number being 292, whereas in 1913 there were 379. In some instances the falling-off is due to territorial changes made by the Treaty of Versailles; some 30 factories were lost in this way, 10 in East and West Prussia, 19 in Posen, and 1 in Alsace Lorraine. In some cases factories were closed down during the war and have not since been opened, but as the acreage under sugar beets is now steadily increasing, no doubt more factories will resume work each year.

The sugar factories are located as centrally as possible among the fields. Competition of the finished product with cane sugar demands this; beet sugar must be sold at least as cheaply as cane sugar. Most of the



FIGURE 12.—Electrically-driven tilting car dumping beets into the washing machine whence they are carried when clean to the slicer.

beets are received from the fields without cost to the factory. The manufacturers, in most cases, supply the seed free of charge in the spring and therefore can demand free delivery in the fall, under these conditions.

In the manufacture of beet sugar, the beets delivered from the storage sheds, after being thoroughly washed, are cut into thin slices or chips. These are then conveyed to a diffusion battery where the sugar is removed from the chips by water at about 85°C ., into which the sugar diffuses. The exhausted chips are pressed, dried by heat, and used as a cattle food. The diffusion juice, containing from 12 to 15 per cent of sugar, is treated with excess of lime to purify it, and the dissolved lime is precipitated by carbon dioxide, after the removal of which, the operations of liming, carbonization, and filtering are repeated. The juice is then evaporated, crystallized, and centrifuged, as in making sugar from cane juice. The raw beet sugar is not suitable for food until it is refined.

In figuring the cost of production, the by-products, all of which are valuable, must be counted as one of the assets to the industry. After extracting the sugar, the farmer can feed the residue from the mill to his livestock. The pulp is either trans-

ferred to large silos for winter feeding, piled green in bulk in the field, or dried for mixing and shipment. The best results have been obtained by partially drying and mixing it with such feeds as molasses, oil cake, ground grain, or chopped hay. In Germany more than one-half the total pulp output is dried, for use in the manufacture of mixed stock feeds. In the artificial drying the amount of water is reduced to about 10 or 12 per cent (from 90 per cent) which represents the average content of water or moisture in hay. The product at this stage resembles green tea in appearance. The drying is for the purpose of decreasing the weight and bulk and to prevent the deterioration of the product from fermentation. The Germans utilize beet pulp, to a limited extent, in the manufacture of paper.

Molasses is an important by-product; it is the liquor from which the



FIGURE 13.—At some factories the beets unloaded on the railroad are transported to the washer by moving belts below the ties.

sugar crystals have been separated. It is also an important source of alcohol. Vinasse or Spent-wash is obtained from molasses by distillation, after separation of the alcohol, and contains the whole of the potash and part of the nitrogen present in the original molasses. It is largely

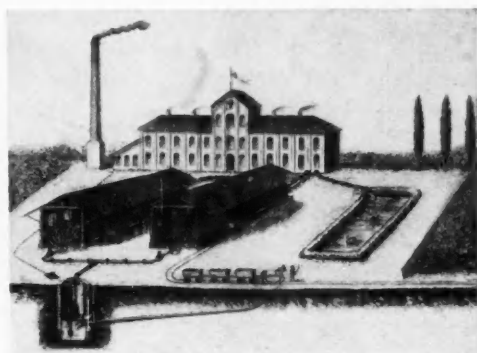


FIGURE 14.—Sugar beet factory showing sheds where the beets are washed by water forced through the troughs.

used as a fertilizer and the potash and nitrogen removed from the field by the beet crop may thus be returned to the soil. Vinasse is often mixed with some absorbent material such as peat before it is put on the fields.

The production of sugar beet seed is a very important branch of the German beet sugar industry. It is owing to scientific seed breeding that the yield of beets per acre and the sugar content have improved so much during the last 50 years. When the industry was in its infancy, the per cent of sugar in the beet was about one-half that of the sugar cane, whereas today the sugar content of beet has been increased three-fold, and is now higher than in the best sugar cane. The modern sugar beet containing over 20 per cent of sugar was evolved from a root containing only 7 per cent of sugar.

Before the war Germany and Russia were the chief commercial producers of seed and grew nine-tenths of the world's supply. The other countries which grew sugar beets imported their seed. Since the war the Russian supply has dwindled, but Germany still holds first place for export of seed.

In 1859 Rabbethge and Giesecke

established a sugar-beet seed farm at Klein Wanzleben, near Magdedurg, which since has grown to be the most extensive sugar beet seed enterprise in the world, comprising 13,000 acres. As the beet sugar industry spread from France and Germany to other countries, they also began to grow seed, but Germany put forth such efforts that the seed growers of other countries were soon driven from the markets of the world and Germany secured a practical monopoly of the business. The dependence of the world upon German seed in 1913 is shown below in Table 3.

TABLE 3
SUGAR PRODUCED FROM GERMAN SEED, 1913 *
(In Tons)

In Germany	3,003,768
In other countries	3,793,365
Total	6,797,133

* Palmer, T. G., *Sugar Beet Seed*, p. 104.

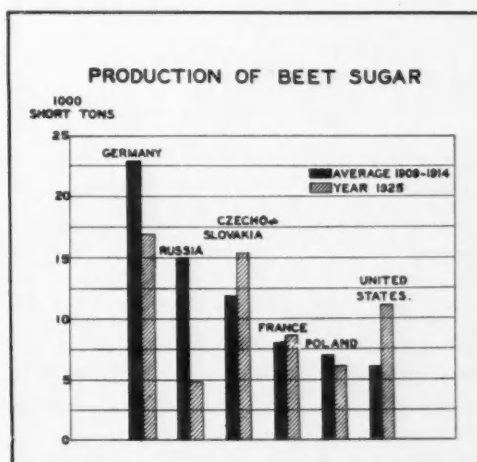


FIGURE 15.—Germany was the chief beet sugar producer in 1913. Though her 1925 production had not reached pre-war level, she had made a good recovery, and had a considerable surplus for export (see Figure 16). (Buechel, "Commerce of Agriculture" and International Crop Report.)

As the world total of beet sugar from all seed was approximately 8,770,000 ⁷ tons, it will be seen that

⁷ Buechel, F., *Commerce of Agriculture*, p. 288.

about three-fourths of this was produced from German seed.

Fig. 15 shows the pre-war and 1925 production of beet sugar in the chief producing countries. The German output in 1913 was 2,304,000 tons, 26 per cent of the total world output, while Russia came next with 17.7 per cent, and the territory which is

beet, 1,190,000 acres as against Germany's 905,000, the German sugar output is heavier than that of Russia by some 500,000 tons.⁸ This is due to the fact that the yield of beets per acre is higher in Germany than in Russia. In 1923 the yield was 10.1 tons in Germany and only 4.8 tons per acre in Russia. This is due, to

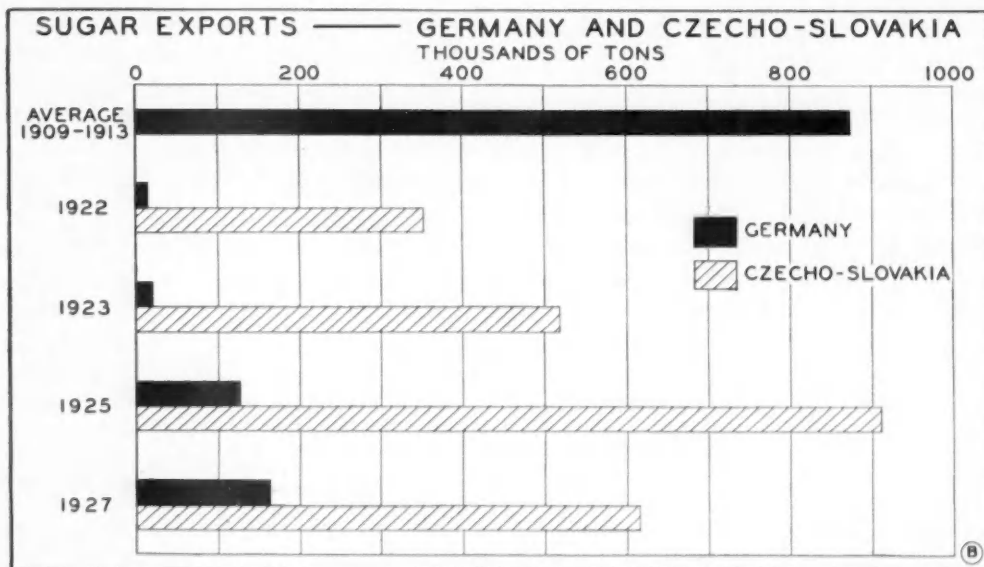


FIGURE 16.—Before the war Germany was the chief exporter of beet sugar. In 1922 her export was almost negligible, her place as exporter being taken by Czecho-Slovakia. At present, though Czecho-Slovakia still holds first place, the German export is steadily increasing. (Yearbook U. S. D. A., 1927.)

now included in Czecho-Slovakia contributed 13.9 per cent. The figures for the season 1924-1925 show a considerable drop in the German production. Russian production has declined from 1,557,000 tons to 501,977, about one-third of her pre-war production. The output in Czecho-Slovakia and the United States, on the other hand, shows considerable increase, while that of France is slightly in excess of the 1913-1914 production.

It is interesting to note that although Russia now has a higher acreage than Germany under sugar

some extent, to the advanced state of agriculture in Germany as compared with methods in Russia.

Germany became a sugar-exporting country about 1871 when the exports exceeded imports by a round 21,000 tons. From that time until the season of 1917-1918 Germany's exports continued to be greater than her imports, reaching a maximum in 1910-1911 when the net export was 1,228,715 tons. The sugar sent abroad went chiefly to England. Probably about one-half of the aver-

⁸ *International Crop Report*, June 1926, p. 290-291.

age (1909-1913) exportable sugar surplus of 953,000 tons originated in the areas which Germany forfeited by the Treaty of Versailles. This meant a big loss to her international balance sheet.

In 1913 Germany was the most important beet sugar-exporting country, with Austria Hungary as close

list of beet sugar-exporting countries.

The German sugar production from 1891 to 1926 is shown in Fig. 17. The trend is generally upward until the outbreak of the World War in 1914, with the exception of two noticeable drops in the years 1904 and 1911. In those years the temperature rose unusually high during

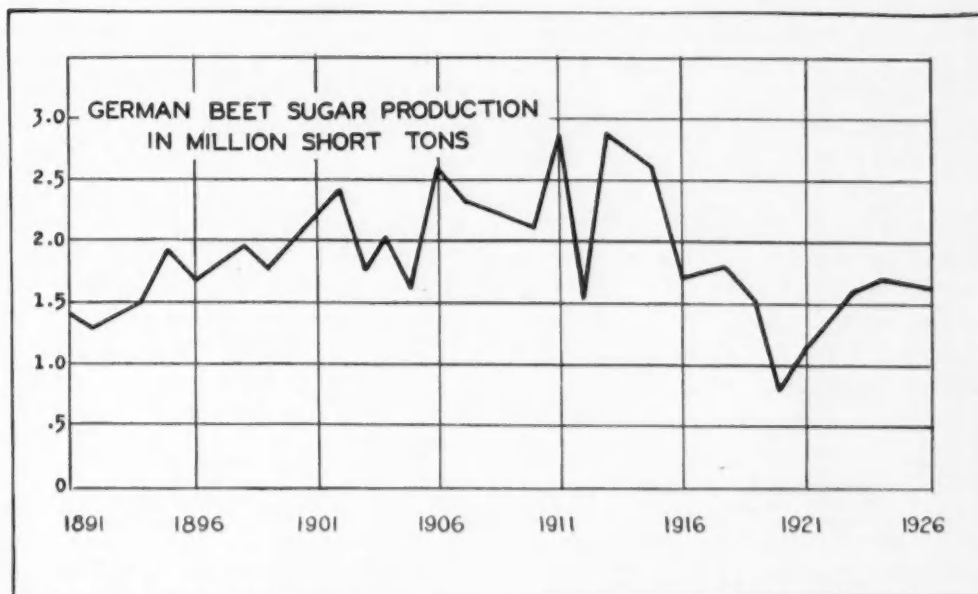


FIGURE 17.—The trend of the German sugar production was generally upward until the war, during which period most of the fields were idle. The upward trend, however, began immediately after the armistice. (Yearbook U. S. D. A., 1923, and International Crop Report, May, 1927.)

second and Russia third. The 1927 statistics (See Fig. 16) show that Czecho-Slovakia now leads in the export market, Germany stands second, while Russia has no surplus for export. Today Czecho-Slovakia is Germany's most dangerous competitor, but since 1922 German export of sugar has increased at a greater rate than that of Czecho-Slovakia, and if this continues Germany will resume her place at the head of the

the maturing season, especially in 1911. This is detrimental to the storage of sugar and no doubt resulted in smaller sugar content of the beet. Between 1914 and 1918 there was a marked decline, owing to the war, but immediately after the cessation of hostilities, fields which had been lying idle for lack of labor were planted with beets, hence the general upward trend of the curve as shown in Fig. 17.

DIVISIONS OF THE PINE FOREST BELT OF EAST TEXAS

William T. Chambers

Geographer, Stephen F. Austin State Teachers College

THE Southern Yellow Pine and Hardwood Forest extends into East Texas approximately to the 40-inch rainfall line and is the natural vegetation of an area varying from 80 to 120 miles in width and extending from the northern boundary of the state to the Gulf Coastal Prairies. The area of this district (23,000 square miles) is about ten times that of Delaware and slightly more than half that of Pennsylvania, but it includes less than an eleventh of the vast state of Texas. It produces almost all the commercial timber output of the state which amounts to one and a half billion board feet annually, and gives Texas sixth or seventh rank among the states in lumber production. Farms in the district produce an average of 440,000 bales of cotton annually which is more than the total for Tennessee and Virginia and forms a tenth of the cotton crop of Texas. Corn is the chief supply crop of the farmer, and legumes and vegetables are produced for home consumption and marketing. Livestock industries have not attained large importance in the region.

This pine forest belt contains two geographic regions—a southern one in which exploitation of forest resources is the dominant economic activity, and a northern one in which agriculture is of outstanding importance.

PINEY WOODS REGION

The southern part of the East Texas Pine Forest Belt is an exten-

sive woodland, cut-over, and forest region much of which is appropriately known as the "Big Thicket" by people living in adjoining areas. Land which is cleared and improved for farming is distributed in small bodies—veritable holes in the wilderness—chiefly in the vicinity of mill towns and the environs of the chief cities as Jasper, Lufkin, Livingston, and Huntsville. Most of the wage earners are engaged in lumbering, sawmilling, and the operation of turpentine camps. The population which gains a livelihood in these industries is the chief basis of wholesale and retail trade, and constitutes an important market for farm produce. The cities contain large sawmills and some other wood-working industries. Towns and rural communities develop at sawmills, logging fronts, and turpentine camps, and many of them are abandoned when the local timber supply is exhausted.

The first step in the utilization of a mature stand of longleaf pine (*P. palustris*) is its development as a turpentine camp. Undergrowth is cut from the forest so that it will not retard the gathering and transportation of the resin, and a turpentine still is erected beside a railroad at a place convenient to the forest and to a source of water for use in cooling the coils of the condenser. Negro laborers called "chippers" cut "streaks" in the trees, and attach galvanized iron aprons and cups to catch the sticky resin which oozes from the wounds. A fresh streak is "hacked" in each tree once a week during the

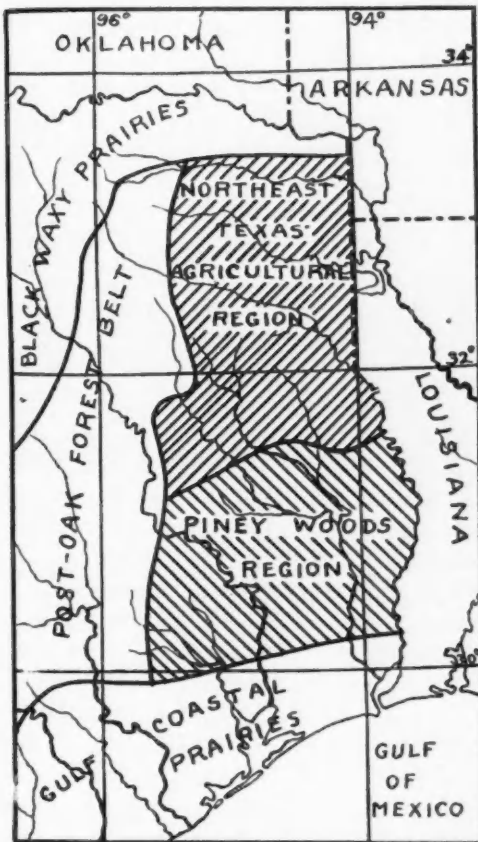


FIGURE 1.—The geographic regions in the Pine Forest Belt of East Texas.

growing season to keep the resin flowing freely. At intervals of ten to fourteen days the resin is collected in barrels, and hauled to the still where it is heated to evaporate the turpentine and moisture. The vapors are condensed, and the turpentine is separated from the water by a gravity process and collected in tank cars or metal drums for transportation to market. The residue is strained to remove chips, bark, and other trash, and poured into barrels to cool. It forms a brittle, amber-colored resin, which is used in the manufacture of soap, paper, and some other commodities.

When a forest has been used as a turpentine camp two or three years,

the cups are moved to other trees, and it becomes a center of logging operations. A spur from the logging railroad is built in the area, and all trees suitable for use as saw timber and within 75 to 100 yards of the track are felled, and their long, straight trunks are cut into logs. A steam engine equipped with long cables to which hooks are attached is used in dragging or "skidding" logs into position beside the track. The logs are placed on cars by a "loader," and transported in train-loads to the mill which in some cases is located more than thirty miles from the logging front.

At the mill the logs are dumped into a pond, and towed to the "slip" up which they are carried by belt conveyers. They are placed on carriages, and moved against band saws which cut them into slabs. Belt conveyers and automatic rollers carry the slabs to other saws which trim off rough edges and cut the boards into standard sizes. Planing machines complete the process of manufacture, and the lumber is loaded upon cars for transportation to market. Some mills make laths from suitable slabs, and all of them use sawdust,



FIGURE 2.—Highway through a pine forest which has been developed as a turpentine camp. Jasper County, Texas (Piney Woods Region).

shavings, and other scraps of wood as fuel for the boilers. Surplus scraps



FIGURE 3.—The chippings on pine trees in a turpentine camp near Zavalla, Texas. At the outset the cup is attached at the base of the trunk, but it is raised and a new apron is inserted each spring when the sap begins to flow.

are sold for use as fire wood, or are dumped into the burner where they are reduced to ashes which have a small market value.

When lumbering operations are finished in an area, the site of the once stately forest becomes a desolate and almost abandoned waste. At the outset the cut-over land is littered with broken and twisted



FIGURE 4.—Turpentine still in operation in the northern part of Newton County, Texas. Resin is brought from the camp in barrels similar to those in the foreground, and delivered beside the still from the elevated drive at the left.

masses of branches and dotted with thousands of desolate stumps. A few solitary and slender pines, too small or imperfect for use as saw timber, stand above the forest wreckage, having survived the falling tim-

ber and the ravages of the powerful skidder. In many cases fire sweeps over the area burning the withered and rotting litter, deadening the larger trees, and consuming the young seedlings which spring up in the sandy soils of the warm and humid region. Piney-woods-rooters, goats, and other livestock range upon the land unless it is fenced, devouring seedlings and retarding the development of second growth timber. Notwithstanding these handicaps the forest has reestablished itself in many places, and it is hoped that the work of the State Department of Forestry and the economic interests of land owners will lead to the reforestation of all land unsuited to higher uses.

Agriculture is still of secondary importance in the Piney Woods Region. Some land was settled before the rise of the lumber industry and agriculture has developed some in recent years, but less than a fifteenth of the total area is used in crop production. Factors which have

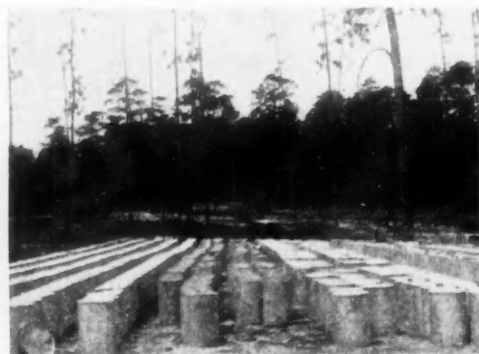


FIGURE 5.—Galvanized iron barrels of resin in the foreground, and a tank car of turpentine and virgin pine forest in the background.

retarded the growth of the industry are the low productivity of cotton and corn when planted in deep sand soils, the inadequate market for vegetable and fruit crops which thrive in the region, the difficulty of



FIGURE 6.—Logging train in a cut-over area in Newton County, Texas.

clearing cut-over land, and the unwillingness of some lumber companies to sell land to farmers. Cotton occupies half of all the land in crops and half as much is planted in corn. These crops are so poorly suited to

duced. These crops yield feeds for livestock and foods for home use and for sale in the mill towns and small cities.

Livestock industries are based upon the utilization of unfenced forest and



FIGURE 7.—Cut-over land near Jasper, Texas.

the land that heavy fertilization and intelligent soil-building are essential to successful production. Ribbon cane, a variety of sugar cane, is grown on alluvial land and used in making molasses. Small quantities of peanuts, sweet potatoes, watermelons, peas, and figs are also pro-

duced on cut-over land as range for cattle, goats, hogs, and sheep. Beef cattle are more than five times as numerous as dairy cows, for they are well suited to life on the range and require relatively little care. They vary from pure-bred to scrub animals, and are shipped to packing plants or slaugh-



FIGURE 8.—Farmstead on highway in the central part of the Piney Woods Region.

tered for sale in local markets. Many goats are raised, for they thrive in the forest and are useful in killing sprouts and as a source of meat. Grade hogs and "piney-woods-rooters" feed by the "root hog or die" system on pine seedlings,



FIGURE 9.—"Piney-Woods-Rooter" and the remnant of her litter in their habitat. Hogs of this type, the product of the struggle for survival in the Piney Woods Region, are being improved by crossing with pure blooded and grade stock.

NORTHEAST TEXAS AGRICULTURAL REGION

Conquest of the forest and development of agricultural industries have



FIGURE 10.—Some sheep are raised in grassy, cut-over areas in the Piney Woods Region.

roots, acorns, and nuts which they find in the forest. Some sheep are grown in grassy, cut-over areas, but they are poorly suited to range life in this warm, moist, wolf-infested land. Chickens and other poultry are unimportant because of the ease with which they fall prey to wild life of the forest including hawks, owls, foxes, and opossums.

made much greater progress in the northern part of the East Texas Pine Forest Belt than in the Piney Woods Region. The presence of sandy loam soils and rather open forest made the area attractive to settlers, and its early occupation was favored by proximity to the sources of Anglo-American migration to Texas and by location on the Old San Antonio Road

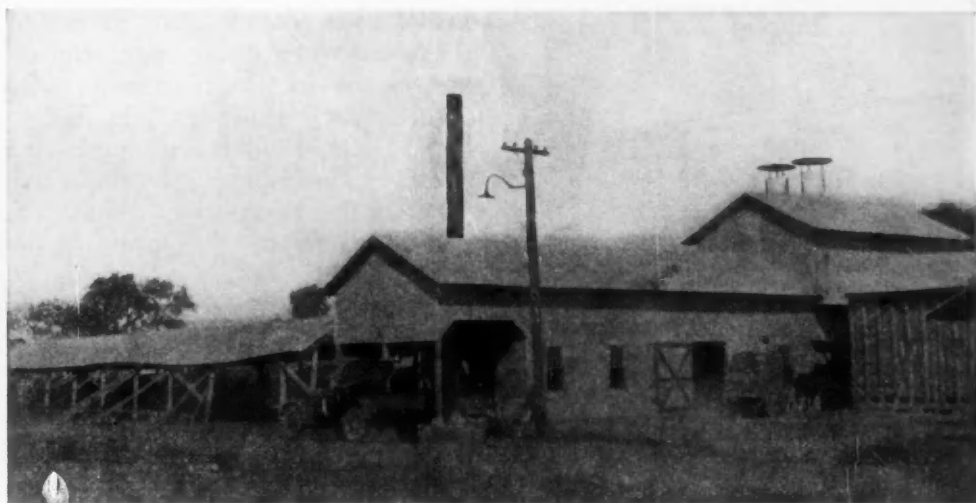


FIGURE 11.—Ginning cotton at Kilgore, Texas. Note the long shed at the left which gives protection from sun and rain to farmers and their seed cotton while waiting to be served at the gin.

along which that migration moved. The early settlements expanded, and the land was divided into farms, so that lumber companies never gained possession of the soil, and agriculture has developed with the conquest of the forest and the improvement of



FIGURE 12.—Corn and peanuts grown in alternate rows on sandy soil in the Northeast Texas Agricultural Region.

transportation and marketing facilities.

Agriculture is the dominant industry of the region. Approximately 60 per cent of the land is in farms,

and half of this amount is cultivated. Typical rural landscapes contain small, undulating, sandy and sandy loam fields interspersed with patches of second growth pine and hardwood forest and dotted with the modest homes of farmers and tenants. More than a fourth of the total area is used in the production of cotton and corn, and there are several legume, vegetable, and fruit crops. Farm woodlands occupy much poor, sandy, and rugged land and alluvial areas which are subject to frequent overflow. Livestock industries are small but dairying is increasing in importance. The region is threaded by railroads and a system of highways and roads which make the towns and villages accessible and converge at the chief urban centers as Texarkana, Marshall, Tyler, Longview, and Nacogdoches. These cities are centers of retail and wholesale trade and have some manufacturing industries.

Cotton is grown on 61 per cent of all the land in crops, and is the chief basis of prosperity among the people. Farmers derive most of their income



FIGURE 13.—Field peas growing on white sand land near Henderson, Texas.

from the sale of staple, and the seeds are used as livestock feeds and fertilizer or in the manufacture of cotton seed oil, cotton seed meal, cotton seed hulls, and linters. The supremacy of the crop is indicated by the large part of the cultivated land it occupies, by the large number of workers who cultivate and harvest the crop, by the location of gins in every community and at road intersections in rural areas, by the presence of cotton compresses, cotton seed oil mills, and cotton yards and warehouses in the chief towns and cities, and by the numerous loads of seed cotton, cotton bales, cotton seeds, and cotton seed products which move by wagon and truck along the roads and highways. Promise of a good yield and a high price for the staple causes optimism and anticipation of prosperity, while the prospect of a small crop and low market value forebodes business depression and financial stringency.

The corn crop is second only to cotton in value to the farmer. It occupies about a third as much land as cotton and more than the total for all other field crops. Good yields are obtained on alluvial and loam upland soils, but the average grain yield is reduced to less than 10 bushels per acre by the niggardly crops obtained on sand soils and in poor, eroded

fields. The yield is also reduced by the practice of growing peas, peanuts, and beans in alternate rows with corn. The grain is used in feeding horses, mules, milch cows, and other livestock, and is an important bread-stuff of the population. Since the crop is inadequate to supply the demand, quantities of corn are shipped into the area from Oklahoma and Kansas.

This cotton and corn growing system of farming has serious deficiencies, but it has survived every attack. The two crops compete for the best land, for neither will yield well on deep sand soil or poor eroded land without liberal fertilization. They compete for labor because each crop is planted in the spring, each requires cultivation during the early part of the growing season, and each is ready to harvest during the late summer and autumn. Since both cotton and corn are intertilled, their production



FIGURE 14.—Sweet potatoes ready for harvesting. This crop was grown on sandy soil near Center, Texas, and marketed in Shreveport.

on 88 per cent of all land in crops accentuates the problem of erosion, so that terracing is advisable even on land having gentle slopes. Notwithstanding these handicaps farmers continue to grow cotton and corn because of the excellence of cotton as a



FIGURE 15.—Field of ribbon cane, a variety of sugar cane, north of Henderson, Texas. This crop is planted on rich alluvial land, and is used in making molasses.

money crop and the value of cotton seeds and corn as supply crops. Other crops are less suitable for large-scale production in the region than these staples, and a program for agricultural development should include the practice of soil-building methods of farming and the production of more cotton and corn per acre.

and supply quantities of food for the population and forage and hay for livestock. Peanuts are hogged down, or are pulled, cured, and stored for winter use. The vines make excellent hay if relatively free of sand, and the nuts are useful as a food and as feed for swine. Stock-peas and velvet beans are grown; and speckled peas, blackeyed peas, and crowder peas are prized as foodstuffs by the population. These crops reduce the cost of living, foster the growth of livestock industries, and tend to increase soil fertility.

The long moist growing season, short mild winters, and abundance of sandy soil favor the growth of vegetables and some berries and fruits. Sweet potatoes, watermelons, tomatoes, and ribbon-cane are important crops. A variety of garden vegetables and figs, peaches, and berries are grown for home use and sale in local markets, and quantities of tomatoes,

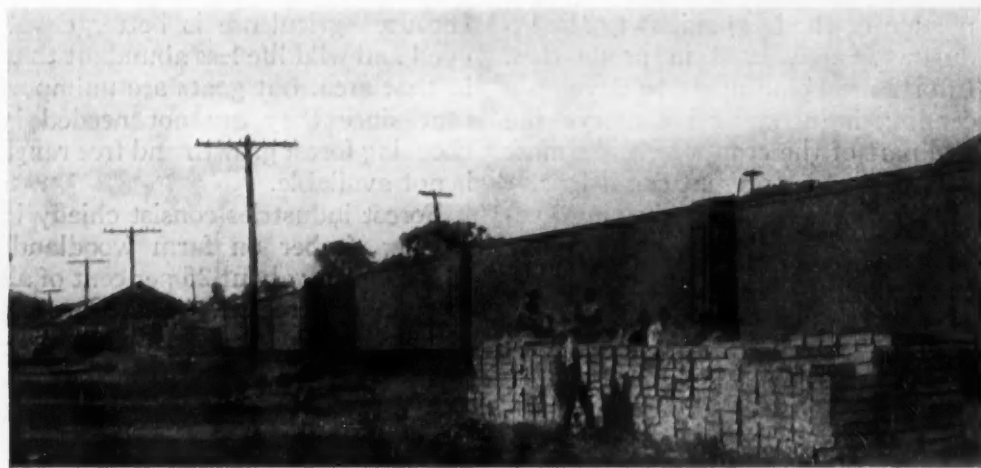


FIGURE 16.—Loading tomatoes for shipment at Dialville, Texas. The crates ricked in the foreground were packed and hauled to the railroad siding by farmers. Tomatoes brought in bulk for shipment are sorted and packed in the long shed in the left background.

Several legumes grow luxuriantly in the loam and sandy soils of the region. They are planted in small fields or in alternate rows with corn,

sweet potatoes, watermelons, and peaches are shipped to market in the North and East. The commercial crop is produced early in the growing

season, for the sandy and loam soils become dry and warm early so that these crops mature while prices are sufficiently high to make their transportation to distant markets profitable. Expansion of the industry is limited by the capacity of available markets at prices which give moderate return to farmers, for only a small



FIGURE 17.—Farm woodland which has a dense stand of young pine. Much sandy and slope land in the Northeast Texas Agricultural Region should be used in growing pine trees.

portion of the land suited to the industry is now used in production. Efforts are being made to develop a canning industry and conserve the late part of the crop which is almost valueless under present conditions.

Dairying is the most thriving livestock industry of the region. Dairy cattle are five times as numerous as in the Piney Woods Region, and the industry is growing in the vicinity of the larger urban centers and along railways which offer service to Shreveport and Dallas. The long, moist growing season facilitates the production of stock feeds including cotton seeds, corn, sorghum, stock-peas, and velvet beans; and by growing oats, rye, wheat, turnips, and vetch during the winter, ample supplies of succulent feed can be obtained to keep dairy cattle in prime condition

at all seasons. The success of the industry is also favored by the small cost of protecting cows from cold, inclement weather, and the ease with which the animals maintain body heat in winter. The eradication of tick fever and the preservation of dairy products in hot weather are not difficult in this age of medical science and of manufactured ice which is available at moderate prices for use in refrigeration. Dairying will develop as the cities in the region and in adjoining areas increase in size, and future production may enable the shipment of butter, condensed milk, and cheese to distant markets.

Other livestock industries are less promising than dairying. Beef cattle and hogs are less numerous than in the Piney Woods Region, for production is limited by the scarcity of feeds suitable for use in fattening animals and the absence of free range for livestock. Poultry is more abundant than in the Piney Woods Region because agriculture is better developed and wild life less abundant than in that area, but goats are unimportant since they are not needed in checking forest growth and free range is not available.

Forest industries consist chiefly in cutting timber on farm woodlands which occupy about 25 per cent of all land in the region. There are no large-scale logging fronts or turpentine camps, but quantities of poles, posts, railroad ties, saw timber, and fire wood are cut especially during the winter. Short leaf pine is the most abundant and valuable tree. It thrives in deep sand and old field land and in areas having steep slopes. Oak, gum, elm, pecan, and other hardwoods grow in alluvial land. The farm woodlands receive little care, but half of them have a fair

stand of timber and they supply wood for use on the farm and much marketable material.

FUTURE UTILIZATION OF THE PINE FOREST BELT

These two regions in the Pine Forest Belt of East Texas seem destined to retain geographic individuality. The Piney Woods Region has an enormous acreage of sand and slope land which is unsuited to cultivation. Much of it has a stand of second growth pine, and most of it will probably be used to grow successive crops of timber, thus perpetuating the forest character of the region and its forest and wood-working industries. Production of vegetable and fruit crops which thrive in the region will increase with the growth of accessible markets and the im-

provement of transportation and marketing facilities, but farming based on the growth of cotton and corn will not succeed in most parts of the area. On the other hand agricultural industries will continue to develop in the Northeast Texas Agricultural Region with tendencies toward greater diversification and intensification in crop production, and increasing attention to livestock industries, especially dairying. Forest industries will be confined to the cutting of timber on farms. Textile mills and some other kinds of factories will probably develop in the cities and towns to make finished products from cotton, wood, milk, vegetables, and fruits produced in the region and use lignite coal mined in the area and the moderate-priced labor of the population.

BOOK REVIEWS

DEPARTMENT OF COMMERCE

Bureau of Foreign and Domestic Commerce

Commerce Yearbook, 1929, Volumes I and II

The first volume was issued recently, and the second volume has just now been released.

Together these two books comprise a comprehensive survey of the United States and foreign countries. Volume I contains detailed information concerning business conditions in the United States and its noncontiguous territories and possessions. It opens with a brief summary of business conditions in the United States for 1928, based upon the most reliable and recent statistical data available in the Department of Commerce and throughout the Government. This is followed by chapters which discuss thoroughly such subjects as recent movements of production and domestic trade; general economic position and progress of the United States; employment, immigration and wages; and the question of wholesale and retail and farm prices. The foreign trade of the United States is given careful consideration from the standpoint both of commodities and regional distribution. Another section of the book deals with agricultural products and foodstuffs. Other commodities, such as fuel and power, construction materials, iron and steel, machinery, automotive products, rubber and rubber products, and in fact all of the important commodities in American manufacture and trade are analyzed.

Volume II—Foreign Countries—has come to be a unique contribution to American business thought. In securing information and statistical data to be used in this volume, the Department of Commerce has enlisted the coöperation of many foreign Governments, who have gladly furnished it immediately and as soon as available, with the latest statistics. This has involved a veritable worldwide enterprise and coöperative activity, carried on principally through the foreign offices of the Department of Commerce throughout the world, and the Consular service of the Department of State.

Through these agencies valuable material available to the geographer and the economist, as well as the business man, from no other source, is compiled within this volume.

Some sixty-five foreign countries are handled separately. Statistics of production and trade, area and population, communications including railways, posts, telegraphs, telephones, and airway information, in addition to finance and currency, are among those given for practically all these countries.

The information at hand has been analyzed carefully, and results given in the text of the book.

Maps and graphs add greatly to the value of these publications. In addition to the black and white maps in the text are a series of colored continent maps at the end of the book.

This volume also is available at \$1.00 from the same source as Volume I.

The publications of this bureau may also be purchased from the bureau of its district offices.

Annual Report of Director of Bureau of Foreign and Domestic Commerce to Secretary of Commerce for Fiscal Year Ended June 30, 1929.

Reviews the activities of the bureau during the past year, showing the part taken by each division. Price, 10 cents.

Index to Commerce Reports, Nos. 26-39, Volume 3, Thirty-second Year, July-September, 1929.

This index is issued quarterly and lists all material published in Commerce Reports by subject, country, and author. Single copies, 5 cents; annual subscription, 20 cents.

South American Markets for Rubber Sundries and Specialties. Trade Information Bulletin No. 658. Price, 10 cents.

Discussion of the extent of the market for rubber goods, competitive conditions, and methods of doing business in the various countries of South America.

Rights of Foreign Shareholders of European Corporations. Trade Information Bulletin No. 659. Price, 10 cents.

Markets for Building Materials: Part II, Mexico, Central America, and West Indies. Trade Information Bulletin No. 660. Price, 10 cents.

Discussion of the kinds of building materials produced and imported in Mexico, Central America, and West Indies.

Leather Trade of Italy. Trade Information Bulletin No. 661. Price, 10 cents.

Market for Foodstuffs in Colombia. Trade Information Bulletin No. 662. Price, 10 cents.

Monthly Summary of Foreign Commerce of United States, July, August, and September, 1929. Part I and II.

Part I contains statistics of exports of domestic merchandise, and imports by articles for July, August, and September, 1928 and 1929, and for seven months ended July, August, and September, 1928 and 1929. Part II contains summaries of export and import trade; monthly average import and export prices; and statistics of trade with Alaska, Hawaii, and Porto Rico. Single copies, Part I, 10 cents; Part II, 5 cents. Annual subscription, \$1.25.

Latin American and Canadian Markets for American Motion-Picture Equipment. Trade Information Bulletin No. 641.

Marketing of Tungsten Ores and Concentrates. Trade Information Bulletin No. 643. Price, 10 cents.

Summary of the properties, uses, world sources, and methods of marketing tungsten ore and concentrates.

British Trade in Rubber and Rubber Products. Trade Information Bulletin No. 644. Price, 5 cents.

Discussion of the crude-rubber production of the British Empire, the production restriction measures adopted and their abandonment, the manufacture of rubber goods in Great Britain, and the British trade in these products.

Export Markets for American Brushes. Trade Information Bulletin No. 645. Price, 5 cents.

Boot and Shoe Industry and Trade in Germany. Trade Information Bulletin No. 646. Price, 10 cents.

Cattle Raising in Argentina. Trade Information Bulletin No. 647. Price, 5 cents.

Discussion concerning cattle raising and the development of the packing industry in Argentina.

Installment Selling of Automobiles in Latin America. Trade Information Bulletin No. 649.

Foreign Trade of United States in Fiscal Year 1928-1929. Trade Information Bulletin No. 650; ii and 22 pages.

Leather Trade of Egypt. Trade Information Bulletin No. 651. Price, 5 cents.

Deals with the production of hides and skins, the methods of tanning, and the leather trade of Egypt.

Representative International Cartels, Combines, and Trusts. By William F. Notz. Trade Promotion Series No. 81. Price, 15 cents.

Appointments to Positions at Home and Abroad in Bureau of Foreign and Domestic Commerce.

Prison Industries. Domestic Commerce Series No. 27. Price, 20 cents.

Sales Territories in Japan. By Paul P. Steintorf, American Trade Commissioner.

French Chemical Industry and Trade in 1928. Trade Information Bulletin No. 652. Price, 10 cents.

Big Five in Japanese Banking. Trade Information Bulletin No. 653.

Budgets of European Countries, 1929: Part II, Western and Central Europe. Trade Information Bulletin No. 654.

Markets for Building Materials: Part I, Canada and Newfoundland. Trade Information Bulletin No. 655.

French Experience with Defaulted Foreign Bonds. Trade Information Bulletin No. 656. Price, 10 cents.

Latin American Financial Developments in 1928. Trade Information Bulletin No. 657. Price, 10 cents.

Automotive Market in Argentina. By Howard H. Tewksbury, American Trade Commissioner. Trade Promotion Series No. 84. Price 20 cents.

BUREAU OF THE CENSUS

Census of Manufactures, 1927:

Buttons. Price, 5 cents.

Manufactured Ice, Refrigerators and Refrigerator Cabinets, and Mechanical Refrigerators. Price, 5 cents.

Petroleum Refining. Price, 5 cents.

Tanning Materials, Natural Dyestuffs, Mor-dants and Assistants, and Sizes. Price, 5 cents.

Wood Preserving, Compiled in Cooperation with Department of Agriculture Forest Service. 7 pages. Price, 5 cents.

Artificial Leather, Linoleum and Asphalted-Felt-Base Floor Coverings, Oilcloth. Price, 5 cents.

Asbestos Products and Stone, Clay, and Glass Industries Not Covered by Separate Reports. Price, 5 cents.

Cash Registers, Adding Machines, and Calculating Machines; Gas Machines and Gas and Water Meters; Scales and Balances; Typewriters and Supplies. Price, 5 cents.

Chocolate and Cocoa Products, Confectionery and Chewing Gum. Price, 5 cents.

Drug Industries: Druggists' Preparations, Patent and Proprietary Medicines and Compounds, Perfumes, Cosmetics, and Other Toilet Preparations; Drug Grinding; Essential Oils. Price, 5 cents.

Flour and Other Grain-Mill Products, Cereal Preparations, Prepared Feeds for Animals and Fowls, Bread and Other Bakery Products. Price, 10 cents.

Hats and Millinery: Hats, Wool-Felt; Hats, Fur-Felt; Hats, Men's Straws; Hats and Caps, Except Felt and Straw; Hat and Cap Materials; Millinery. Price, 5 cents.

Lime and Marble, Granite, Slate, and Other Stone Products. Price, 5 cents.

Milk Products: Butter, Cheese, and Condensed and Evaporated Milk, Ice Cream. Price, 5 cents.

Miscellaneous Fiber and Textile Products: Cordage and Twine; Jute Goods; Linen Goods; Dyeing and Finishing Textiles; Flax and Hemp, Dressed; Haircloth; Mats and Matting, Grass and Coir; Waste. Price, 5 cents.

Ship and Boat Building. Price, 5 cents.

Stoves and Ranges, Heating Apparatus, and Steam Fittings, Plumbers' Supplies, Not Including Pipe or Vitreous-China Sanitary Ware. Price, 5 cents.

Women in Gainful Occupations, 1870-1920, Study of Trend of Recent Changes in Numbers, Occupational Distribution, and Family Re-

lationship of Women Reported in Census as Following Gainful Occupation. By Joseph A. Hill. Census Monographs IX. Price, \$1.50.

Earnings of Factory Workers, 1899-1927, Analysis of Pay-Roll Statistics. By Paul F. Brissenden. Census Monographs X. Price, \$1.50.

Financial Statistics of Cities Having Population of Over 30,000. 1927. Price, \$1.25.

Prisoners' Antecedents: Statistics Concerning Previous Life of Offenders Committed in 1923 to State and Federal Prisons and Reformatories, Supplementary to "Prisoners, 1923." Price, 15 cents.

BUREAU OF FISHERIES

Annual Report of Commissioner of Fisheries to Secretary of Commerce for Fiscal Year Ended June 30, 1929. Price, 5 cents.

Review of Weakfishes (Cynoscion) of Atlantic and Gulf Coasts of United States, with Description of New Species. By Isaac Ginsburg. Document No. 1058. (From Bulletin of Bureau of Fisheries, Vol. XLV, 1929, pp. 71-85.) Price, 10 cents.

Whitefish, Grayling, Trout, and Salmon of Intermountain Region. By S. B. Locke. Document No. 1062. (Appendix V to Report of Commissioner of Fisheries for Fiscal Year 1929, pp. 173-190.) Price, 10 cents.

Keokuk Dam and Fisheries of Upper Mississippi River. By Robert E. Coker. Document No. 1063. (From Bulletin of Bureau of Fisheries, Vol. XLV, 1929, pp. 87-139.) Price, 30 cents.

Alaska Fishery and Fur-Seal Industries in 1928. By Ward T. Bower. Document No. 1064. (Appendix VI to Report of Commissioner of Fisheries for Fiscal Year 1929, pp. 191-332.) Price, 25 cents.

Bibliography on Cod-Liver Oil in Animal Feeding, with Non-critical Comments and Abstracts. By John Ruel Manning. Document No. 1065. (Appendix VII to Report of Commissioner of Fisheries for Fiscal Year 1929, pp. 333-365.) Price, 10 cents.

BUREAU OF MINES

Nineteenth Annual Report of Director of Bureau of Mines to Secretary of Commerce for Fiscal Year Ended June 30, 1929. Price, 10 cents.

Report on the various activities of the bureau during the year.

Facts relating to Production and Substitution of Manufactured Gas for Natural Gas. By William W. Odell. Bulletin 301. Price, 35 cents.

Ochers and Mineral Pigments of Pacific Northwest: Occurrence, Possible Methods of Preparation, and Testing of Ochers, Siennas, and Colored Clays. By Hewitt Wilson. Bulletin 304. Price, 15 cents.

Mining Methods and Practice in Michigan Copper Mines. By W. R. Crane. Bulletin 306. Price, 60 cents.

Flow of Gases Through Beds of Broken Solids. By C. C. Furnas. Bulletin 307. Price, 30 cents.

Study of physical and chemical reactions of the flow of gases through beds of broken solids in blast furnaces.

Drilling and Blasting in Metal-Mine Drifts and Crosscuts. By E. D. Gardner. Bulletin 311. Price, 40 cents.

Summarized Data of Gold Production. By Robert H. Ridgway. Economic Paper 6. Price, 20 cents. Information regarding production of gold in different countries of the world.

Economics of New Sand and Gravel Developments. By J. R. Thoenen. Economic Paper 7. Price, 15 cents.

Advanced Mine Rescue Training: Part II, Instructions in Methods of Sampling and Use of Bureau of Mines Portable Orsat Apparatus for Analyzing Mine Gases. By W. P. Yant and L. B. Berger. Miners' Circular 34. Price, 20 cents.

Mineral Resources of United States, 1926: Part I, Metals. Price, \$1.25.

Mineral Resources of United States, 1928:

Iron Ore, Pig Iron and Steel in 1928. (Pt. I, pp. 29-68.) Price, 10 cents.

Platinum and Allied Metals in 1928. (Pt. I, pp. 7-20.) Price, 5 cents.

Slate in 1928. (Pt. II, pp. 41-53.) Price, 5 cents.

Sulphur and Pyrites in 1928. (Pt. II, pp. 55-65.) Price, 5 cents.

Analysis of Kansas Coals. Technical Paper 455. Price, 10 cents.

Mineral Resources of United States, 1927:

Gold, Silver, Copper, Lead, and Zinc in Arizona in 1927. (Pt. I, pp. 731-744.) Price, 5 cents.

Gold, Silver, Copper, Lead, and Zinc in Utah in 1927. (Pt. I, pp. 637-676.) Price, 10 cents.

Mineral Resources of United States in 1928 (Preliminary Summary). Introduction by Frank J. Katz; statistics assembled by Martha B. Clark. Price, 20 cents.

Carbon Black in 1928. (Pt. II, pp. 31-35.) Price, 5 cents.

Fuller's Earth in 1928. (Pt. II, pp. 37-40.) Price, 5 cents.

BUREAU OF NAVIGATION

American Documented Seagoing Merchant Vessels of 500 Gross Tons and Over, August, 1929. Published monthly. Single copies, 10 cents; annual subscription, 75 cents.

Annual Report of Commissioner of Navigation to Secretary of Commerce for Fiscal Year Ended June 30, 1929. Price, 5 cents.

American Documented Seagoing Merchant Vessels of 500 Gross Tons and Over, October, 1929. Published monthly. Single copies, 10 cents; annual subscription, 75 cents.

Same, November, 1929.

Seagoing Vessels of United States, 1929. Price, 75 cents.

American Documented Seagoing Merchant Vessels of 500 Gross Tons and Over, September, 1929. Published monthly. Single copies, 10 cents; annual subscription, 75 cents.

COAST AND GEODETIC SURVEY

Tide Tables, United States and Foreign Ports for Year 1930. Serial No. 439. Price, 75 cents.

This publication contains tables showing the rise and fall of tide for every day of the year at the important ports of the world. It also gives the time of the rising and setting of the sun and moon in various parts of the world.

Distances Between United States Ports. Serial No. 444.

This is one of the Coast Pilot Series.

Catalogue of Charts, Maps, Coast Pilots, Tide Tables, and Current Tables of Philippine Islands, August 1, 1929. Serial No. 451.

Catalogue of U. S. Coast and Geodetic Survey Charts, Maps, Coast Pilots, Tide Tables, Current Tables, September 1, 1929. Serial No. 454.

Precise Leveling in Texas. By H. G. Avers. Special Publication No. 77. Price, 25 cents.

Contains surveying data for the State of Texas.

Tidal Bench Marks, State of Massachusetts. By L. A. Cole. Special Publication No. 155. Price, 10 cents.

Descriptions and elevations of tidal bench marks on Massachusetts coast.

Annual Report of Director, United States Coast and Geodetic Survey, to Secretary of Commerce for Fiscal Year Ended June 30, 1929. Price, 15 cents.

United States Coast Pilot, West Indies: Porto Rico and Virgin Islands. Serial No. 446. Price, 75 cents.

Manual of First-Order Leveling. By Henry G. Avers. Special Publication No. 140. Price, 30 cents.

Contains general surveying instructions of the Coast and Geodetic Survey, with a summary of methods employed by the Survey in field and office computations.

Instructions, Primary Tide Stations. Special Publication No. 154. Price, 10 cents.

Instructions for collecting data for the rise and fall of tide in any locality and for the study of crustal movements in the earth.

LIGHTHOUSE SERVICE

Annual Report of Commissioner of Lighthouses to Secretary of Commerce for Fiscal Year Ended June 30, 1929. Price, 5 cents.

Report on the activities of the Lighthouse Service during 1929, with statistical data on aids to navigation.

OFFICE OF THE SECRETARY

Annual Report of Director of Aeronautics to Secretary of Commerce for Fiscal Year Ended June 30, 1929.

Airports and Landing Fields. Aeronautics Bulletin No. 5.

Airworthiness Requirements of Air Commerce Regulations. Aeronautics Bulletin No. 7-A. *Customs Ports Authorized to Issue Marine Documents.* Ninth edition of Department Circular No. 249; 2 pages.

Radio Service Bulletin, September, October, 1929.

Issued monthly by the Radio Division of the Department of Commerce. Contains list of radio stations and references to current radio literature. Single copies, 5 cents; annual subscription, 25 cents.

Air Commerce Bulletin, September 15, 1929.

Air Marking. Aeronautics Bulletin No. 4.

Description of the system recommended by the Department of Commerce for marking aviation landing fields, airports, and direction indicators on roofs of buildings.

Air Commerce Regulations. Aeronautics Bulletin No. 7.

Airport Management. Aeronautics Bulletin No. 17.

Suggested City or County Aeronautics Ordinance and Uniform Field Rules for Airports. Aeronautics Bulletin No. 20.

Air Commerce Bulletin, August, September, October, November, 1929.

Radio Service Bulletin, July, 1929. Price, 15 cents.

Issued monthly by the Radio Division of the Department of Commerce. Contains list of radio stations and references to current radio literature.

Survey of Non-utilized Wood in North Carolina, Report of Sub-committee of National Committee on Wood Utilization Coöperating with State of North Carolina Department of Conservation and Development. Price, 20 cents.

Study of the forest resources of North Carolina, the amount of non-utilized wood produced, and methods of disposal of this wastage.

HELEN M. STRONG.

A Map of the World's Drugs. National Wholesale Druggists' Association, New York. 1929. Compiled by Edwin L. Newcomb.

The National Wholesale Druggists' Association of New York has recently published a drug map of the world, on Mercator's projection,

measuring 35 x 61 inches, intended to be displayed in drug-store windows during "National Pharmacy Week," which was the third week in October. It was compiled by Edwin L. Newcomb, and shows the approximate sources of about 225 standard drugs, by means of their names inserted at the proper places. The drugs named are those which come from more or less restricted regions, and they are nearly all crude vegetable drugs; for products of animal origin (such as honey, beeswax, cod-liver oil, and lard) and manufactured, synthetic, and inorganic drugs, can be produced in almost any country.

The first glance at the map shows that drug plants are very unevenly distributed over the earth. It is not surprising that they are scarce or absent in cold and arid regions; but there is a marked concentration of them in many mountainous regions. This may of course be mostly because mountains generally retain much of their original wild flora, while most medicinal plants which may have originally inhabited fertile plains have given way to cultivated crops. But it is also possible that the soil has something to do with it. For some reason not at present understood, medicinal plants seem to be scarce in both acid and alkaline soils; but mountains on the whole seem to have soils approximately neutral. Such a soil preference is suggested by the scarcity of drug plants in the pine lands of the southeastern coastal plain where acid soils predominate, and in the western half of the United States where the soils are generally alkaline, except in the mountains where precipitation exceeds evaporation.

Another interesting coincidence is that most of the medicinal plants in the United States seem to grow where the early and late summer precipitation is approximately equal; but this may be merely one of the factors that determines the soil conditions. Information is lacking at present as to whether a similar correlation can be made in other continents.

There are probably also some human factors (besides the amount of forest and crop land already referred to) involved in the location of commercial sources of drugs. Of course, any such plants that may grow in sparsely settled or uncivilized regions, like the interior of South America and Africa, are likely to be overlooked unless they are very important (e.g., quinine). On the other hand, in some parts of the world most of the inhabitants are too intelligent and prosperous to spend much of their time in such relatively simple and unremunerative business as digging up roots. This may be another explanation of why so few of our drug plants come from the western half of the United States; for the

western mountaineers are far more prosperous than the eastern ones.

There seem to be no statistics on the number of people in the United States whose main occupation is gathering medicinal plants, or the value of their harvest, but in the occupation table of the Mexican census of 1921, 186 persons are classed as diggers of roots, and 1812 as gatherers of chicle gum (in a population of 14,334,780). In this country probably most of the herb gatherers are farmers primarily, and they go out after drug plants only when farm work is not pressing.

If we interpret the tropics mathematically as that portion of the earth bounded by the Tropics of Cancer and Capricorn, 159 of the drug plants mapped by Dr. Newcomb come from the North Temperate zone, 59 from the tropics, and only 5 from the South Temperate zone. Only a few are common to temperate and tropical regions. Dividing them by continents and smaller divisions, we find that Canada has 17, eastern United States 88, western United States 14, Mexico and Central America 13, the West Indies 11, South America 24, Europe 69, western Asia 24, eastern Asia 40, Africa 29, and Australia and Polynesia 5. This grouping, of course, involves more duplication than the zonal one, for several species are common to different continents, or native in one and introduced or cultivated in another; and sometimes the same drug is obtained from two or more related species of plants which grow in different regions.

It is possible that a similar map prepared in some European country would show more drug plants in Europe and fewer in America, for the list of official plants varies in different countries, and each country naturally is partial to its own products. The number of recognized drug plants tends to decrease from one decade to another, however, with the substitution of synthetic products and surgical processes for the old herb medicines.

By size and other factors, the drug plants of temperate regions may be classed as follows:—Large trees 16, small trees 10, woody vines 2, shrubs 25, herbs 100, and cellular cryptogams 6. In the tropics 25 are trees (large or small), 5 woody vines, 11 shrubs, and 11 herbs, according to the best information at present available. Nearly all parts of plants are used, from roots to seeds.

An analysis of the chemical or therapeutic properties of all these drugs by zones, and countries would doubtless show some interesting contrasts, but would be a rather difficult matter, for many drugs have several different properties, some more important than others.

ROLAND M. HARPER.

ANNOUNCEMENT

THE series on the *Agricultural Regions of South America* by Dr. Clarence F. Jones is completed in this issue.

In the next issue Dr. O. E. Baker resumes his series on the *Agricultural Regions of North America*, and Dr. Griffith Taylor's series on the *Agricultural Regions of Australia* will begin.

Agricultural Regions of Africa, by Homer L. Shantz of the University of Illinois and president-elect of the University of Arizona; and *of Asia*, by Samuel Van Valkenburg of the College of the City of Detroit will follow in later issues to complete the finest geographic discussion of the world's agriculture thus far published.

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Only a limited number of the first numbers of ECONOMIC GEOGRAPHY are available.

The October issue of Volume 5 contains the following articles:

Geography's Part in the Plant Cost of Iron and Steel Production at Pittsburgh, Chicago, and Birmingham, Langdon White, Randolph-Macon Woman's College.
Readjustments in Post-War Cotton Culture, Earl C. Case, University of Cincinnati.
Tung Oil: Florida's Infant Industry, M. Ogden Phillips, Formerly, University of Florida.
The Farm Problem, Robert Stewart, University of Nevada.
Forest Regeneration in Porto Rico, William D. Durland, Formerly, University of Porto Rico.
The Topographic Map of the United States, Guy Elliott Mitchell, U. S. Geological Survey.
Agricultural Regions of South America, Clarence F. Jones, Clark University.

July includes:

Canada's Advance to Hudson Bay, Harold S. Patton, University of Cincinnati.
Economic Conditions in St. Vincent, B. W. I., G. Wright, Imperial College of Tropical Agriculture, Trinidad.
Economic Geography of the Hawaiian Islands, Otis W. Freeman, State Normal School, Cheney, Washington.
Agricultural Regions of South America, Clarence F. Jones, Clark University.
Iron and Steel Industry of the Cleveland District, John B. Appleton, University of Illinois.

April includes:

Agricultural Regions of South America, Clarence F. Jones, Clark University.
The Potash Industry of Europe, Fred S. Mohme, University of Illinois.
The Sugar Industry of the British West Indies and British Guiana with Special Reference to Trinidad, C. Y. Shephard, Imperial College of Tropical Agriculture.
Iron and Steel Industry of the Middlesbrough District, John W. Frey, University of Wisconsin.
The Grape Industry of Spain and Portugal, W. O. Blanchard, University of Illinois, and Elizabeth R. Blanchard.
The Philippine Lumber Industry, Luis J. Borja.

January includes:

Industrial China, H. F. James, Wharton School of Finance and Commerce.
Land Resource Inventory of Michigan, Carleton P. Barnes, Michigan Land Economic Survey.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.
Scranton's Industrial Integrity, Clifford M. Zierer, University of California at Los Angeles.
A Critical Situation in Two One-Crop Wheat Farming Districts in California, John W. Coulter, University of Hawaii.

The October issue of Volume 4 contains the following articles:

Fisheries of the South Atlantic and Gulf States, J. H. Matthews, Atlantic Coast Fisheries Company.
The Iron and Steel Industry of the Birmingham, Alabama, District, Langdon White, Randolph-Macon Woman's College.
America's Resources in Nitrogen, Potash and Phosphorus, Guy E. Mitchell, U. S. Geological Survey.
Possibilities of Rubber Production in Caribbean America, Jewell Venter, University of Missouri.
The Kentucky Geographical Surveys: A Review, W. Elmer Ekblaw, Clark University.
Agricultural Regions of North America, Oliver E. Baker, U. S. Dept. of Agriculture.

July includes:

The Civilizing Rails, Mark Jefferson, State Normal School, Ypsilanti, Michigan.
Piedmont North Carolina and Textile Production, Jefferson Bynum, University of North Carolina.
Location Factors in the Iron and Steel Industry, Richard Hartshorne, University of Minnesota.
The Ozark Orchard Center of Southern Illinois, Ina C. Robertson, State Teachers College, Valley City, North Dakota.
Agricultural Regions of South America, Clarence F. Jones, Clark University.
Egypt Is the Nile, Paul F. Gemmill, University of Pennsylvania.

Single copies of back numbers of Volumes 1 and 2, 1925 and 1926, will be sent to any American address for \$1.75 each; to any foreign address for \$2.00. Back numbers of Volume 3, 1927, Volume 4, 1928, and Volume 5, 1929, will be sent to any American address for \$1.50 each; to any foreign address for \$1.75. Whole volumes may be obtained at the yearly rate.

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